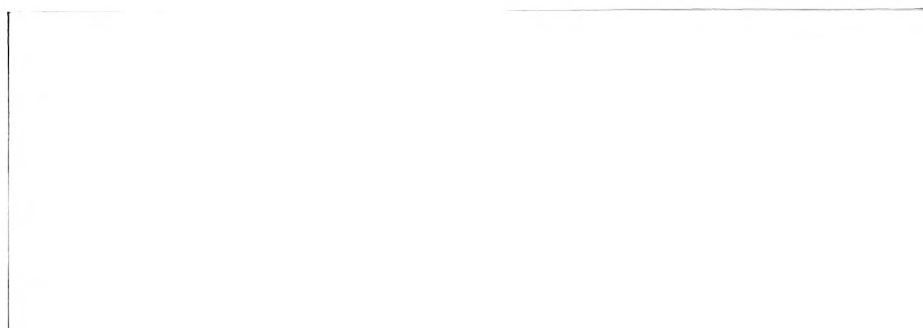


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REPORT ON
SUBSURFACE INVESTIGATION AND
FOUNDATION DESIGN AND
CONSTRUCTION RECOMMENDATIONS
ONE LINCOLN STREET DEVELOPMENT
BOSTON, MASSACHUSETTS



REPORT ON
SUBSURFACE INVESTIGATION AND
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ONE LINCOLN STREET DEVELOPMENT
BOSTON, MASSACHUSETTS



by

Haley & Aldrich, Inc.
Cambridge, Massachusetts

for

Metropolitan/Columbia Plaza Venture
Boston, Massachusetts

File No. 06691-00

April 1989





5 April 1989
File No. 06691-00

Metropolitan/Columbia Plaza Venture
200 State Street, 12th Floor
Boston, Massachusetts 02109

Attention: Mr. Paul Chan

Subject: Proposed One Lincoln Street Development
Boston, Massachusetts

Gentlemen:

We are pleased to submit five copies of our final design report entitled "Subsurface Investigation and Foundation Design and Construction Recommendations, One Lincoln Street Development, Boston, Massachusetts". This report summarizes the results of recent subsurface explorations and presents foundation design criteria and construction recommendations for the proposed One Lincoln Street Development in Boston, Massachusetts. A draft of this report was submitted to Metropolitan/Columbia Plaza Venture on 9 March 1989. Subsequent comments have been incorporated into this final report. The study was undertaken in accordance with our proposal dated 25 October 1988, and your subsequent authorization.

Accompanying this investigation was a site assessment relative to the Massachusetts Oil and Hazardous Material Release Act (MGL Chapter 21E). The results of that assessment were presented in our report entitled "Report on Oil and Hazardous Site Evaluation, One Lincoln Street Development, Boston, Massachusetts," dated 7 March 1988.

Prior to the present study, Haley & Aldrich, Inc. conducted a preliminary geotechnical evaluation on the construction feasibility of the proposed development based on readily available subsurface information in our files. The results of that study were presented in our report to Jung/Brannen Associates, Inc., dated 6 May 1988.

Based on the results of subsurface explorations conducted and architectural-structural project information available at this time, it is recommended that the foundation for the proposed One Lincoln Street Development be designed as follows:

- o The proposed building with five below-grade parking levels may be supported on reinforced concrete footings bearing on the dense to very dense glacio-marine silt and/or glacial till deposits. The lowest basement floor may be designed as an earth supported slab-on-grade with an underdrain system.
- o The perimeter of the foundation excavation along the existing Bedford Building may be supported by a tangent-pile wall constructed by conventional drilled shaft installation procedures. Alternatively, the excavation may be supported by a concrete diaphragm wall constructed by slurry-trench technique. Both systems may be braced externally by tiebacks.
- o Support the remaining larger portion of the perimeter of the foundation excavation by a system of soldier piles and wood lagging using conventional drilled shaft installation procedures and braced externally by tiebacks.

Results of subsurface explorations are presented in Section III of the report. Detailed foundation design recommendations for the proposed building are included in Section IV. Construction considerations are summarized in Section V.

We have appreciated and enjoyed the opportunity to undertake these geotechnical investigations and look forward to our



Metropolitan/Columbia Plaza Venture
5 April 1989
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continued association with the project. If you have any questions, or require additional information, please do not hesitate to contact us.

Sincerely yours,
HALEY & ALDRICH, INC.




David W. Campo
Senior Engineer



Cetin Soydemir
Vice President



Thomas K. Liu
President 

DWC:CS:TKL:aw/0022y



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I. INTRODUCTION

1-01. GENERAL

This report presents the results of recent subsurface explorations and presents foundation design criteria and construction recommendations for the proposed One Lincoln Street Development project in Boston, Massachusetts.

The proposed site, located as shown on Figure 1, "Project Locus", is bordered by Kingston, Bedford, Lincoln and Essex Streets, in the city of Boston. Currently, the site is occupied by several structures including the 10-story Bedford Mechanical Garage, two 5-story buildings and two paved, open parking lots.

The proposed project is planned to consist of a single building having a 35 to 38-story office tower located in the southeast portion of the site. Low-rise portions of 6 to 10 stories are planned for the remainder of the site area. Five levels of below-grade parking are planned beneath both the low and high-rise portions of the building. For the purpose of this study, it is assumed that the project will occupy the entire site and all existing on-site structures will be demolished to allow for the new development.

The project is being developed by Metropolitan/Columbia Plaza Venture. Our work has been coordinated with Jung/Brannen Associates, Inc., (J/B) project architect, and Weidlinger Associates, Inc., (WA) project structural engineer.

1-02. PURPOSE AND SCOPE

The purpose of the study was to evaluate subsurface conditions at the site and to develop foundation design criteria and construction recommendations. The scope of our investigations was as follows:

- o Accumulate readily available data on subsurface soil and rock conditions and groundwater levels near the project site.



- o Gather readily available information on foundations of existing buildings within the site limits and those nearby.
- o Develop and undertake a program of subsurface explorations to obtain soil, rock and groundwater information at the project site. In addition to the geotechnical requirements, subsurface explorations were also to meet the needs of the Chapter 21E site assessment.
- o Expose, observe and document the type, geometry and physical conditions of the foundation of the existing five-story building at 99 Bedford Street (The Bedford Building).
- o Conduct engineering evaluations and develop foundation design and construction recommendations.

1-03. AVAILABLE INFORMATION

The following information pertinent to the project site and the proposed development was provided to us during the course of our investigations:

- A. Site plan entitled "Topographic Plan of Land, Boston, Massachusetts", by Survey Engineers of Boston, dated 25 August 1988; Drawing No. 255.02L.
- B. Architectural plans entitled "Kingston/Bedford Development Plan", by Jung/Brannen Associates, Inc., dated 6 January 1989; Drawing Nos. 4,12-14,16,19-27. Finished floor elevations shown on these drawings are referenced to a particular project datum. It is our understanding that adding 24.5 ft. to the proposed floor elevations on these plans corresponds to elevations relative to Boston City Base (B.C.B) datum.
- C. Preliminary foundation plans and the anticipated range of column loads for both steel and concrete framing schemes, from Weidlinger Associates. This preliminary information was presented on two foundation plans, one for each framing scheme as follows:
 - o Concrete framing scheme; entitled "Foundation Level", drawing CS-1, dated 2 December 1988, scale 1 in.= 20 ft.



- o Steel framing scheme; entitled "Foundation Level", drawing S-1, dated 7 November 1988, scale 1 in. = 20 ft.
- D. Site utility plan entitled "Utility Plan of Land, Boston, Massachusetts", by Survey Engineers of Boston, dated 25 August 1988; Drawing No. 255.03L.

1-04. SITE LOCATION AND CONDITIONS

The proposed site, located as shown on Figure 2, "Site and Subsurface Exploration Plan", is bordered by Kingston, Bedford, Lincoln and Essex Streets, in Boston, Massachusetts. Columbia Street runs in a north-south direction across the site.

The site is part of the original Boston peninsula and is located in the southwest section of an area formerly known as the Southern Cove. Much of the area was originally marshland. Early development of the site in the 1600's consisted mainly of residential structures along the higher elevation portion of the site along Bedford Street. Site filling began in 1722 and continued into the early 1800's with the lot remained as open fields and gardens during much of this period. During the second half of the 1800's, private houses constructed on the site gave way to businesses as the area became the center of the City's shoe and leather trade, in the form of wholesale dealers and selling of shoes that were produced in factories outside the City.

By the late 1800's numerous buildings ranged from approximately three to six stories were constructed on the site. The buildings were used primarily as office space, store frontage, machine shops and wholesale business to include shoes and leather goods.

Currently, the site is occupied by several structures including the five to 10-story Bedford Street Mechanical Parking Garage, two five-story brick buildings at No. 84 and Nos. 88-100 Kingston Street. The remainder of the site consists of two asphalt paved, open parking lots as shown on Figure 2.

Immediately adjacent the site is a five-story historical brownstone at 99 Bedford Street (The Bedford Building), which was built in 1876.



Records in the Boston Building Department and the Boston City Library (plan room) were researched in an attempt to locate foundation information of the above noted existing structures, but no such information was found. However, visits to these buildings revealed that the existing structures have only one basement level below-grade. Records were available to indicate that a 10-story parking garage once occupied the parking lot south of the Bedford Building, with two basement levels below-grade.

In addition, it is important to note that a site visit to the Bedford Building established that a below-grade vault exists under the sidewalk along the Columbia Street side of the building. The vault is apparently an extension of the basement of the Bedford Building approximately to the curblineline of Columbia Street and is about 5 ft. wide. Access to the vault is provided by a number of doors in the basement of the building. Various utilities for the building were observed within the vault.

Site topography exhibits approximately 10 ft. of grade difference proceeding from north to south across the site. Ground surface ranges from approximately El. 25 to 29 along Bedford Street to about El. 19 along Essex Street. Ground surface elevations shown on Figure 2 and referred to in this report are referenced to Boston City Base (B.C.B.) elevation datum.

Other major below-grade structures adjacent to the site include the following (Refer to Figures 2,3 and 4):

- o 99 Summer Street Building is a 20-story, granite faced building with two basement levels below grade. The top of the lowest floor slab is at approximately El. 4. The building is founded on spread footings bearing on the glacial till deposits at approximately El. 1 to 5 along the Bedford Street side of the building.
- o Boston Edison Facility is a multi-story steel-framed electric substation along Kingston Street with one basement. The top of the lowest floor slab is at approximately El. 13. The building is supported by caissons bearing on the glacial till at approximately El. -20.



- o The John F. Fitzgerald Expressway Tunnel is located at the southeast corner of the site directly beneath the Surface Artery, approximately 8 to 10 ft. from the project site boundary. The tunnel invert is at approximately El. -3 where closest to the site. The bottom of the soil-supported tunnel (bearing on the marine clay) is at approximately El. -8 in this area.
- o A major telephone duct is believed to be located between the Expressway tunnel and the proposed structure. In fact, as shown on the site utility plan (referenced in Section 1-03.D) the duct is shown to extend several feet into the proposed project footprint. Record drawings indicate that the duct is approximately 42 in. wide, 10 ft. in height, and is 15 ft. below ground surface. The duct is reported to house 120, 4-in. diameter pipes (containing fiber optic cables) encased with approximately 4 in. of concrete cover all around. The actual location of the duct will have to be verified prior to construction.
- o A 48-in. diameter sewer is located adjacent to the telephone duct. The reinforced concrete sewer invert is at approximately El. 5 where nearest the site as the sewer passes between the site boundary and the Expressway tunnel.
- o 125 Summer Street Building is a 23-story building having five levels of below-grade parking. This building is currently under construction. Lowest floor level is at El. -21.0. The building was constructed by the "up-down" construction technique. The foundation walls are cast-in-place concrete diaphragm walls which are continuous along Lincoln Street and extend to bedrock, at approximately El. -45.
- o Numerous other utilities are present directly below the streets bordering the site and adjacent to the existing Expressway tunnel that will require support during construction. In addition, utilities located within Columbia Street will have to be relocated or abandoned.

1-05. PROPOSED DEVELOPMENT

The proposed development will consist of a single building with a 35 or 38-story tower (depending on the structural framing scheme) to be located in the southeast portion of the site. A low-rise structure of 6 to 10 stories is planned for the



remainder of the site area. The final framing scheme, steel or concrete, has not been determined at this time. The mechanical floor and cooling tower will extend above the top floor reaching a total height of approximately 508 ft. We understand that the total height of the building would remain the same regardless of the framing scheme selected. Five levels of below-grade parking is planned under both low and high-rise portions of the building.

The project will occupy the entire site with the exception of about half of the width of Columbia Street along the Bedford Building. All the on-site structures will be demolished to allow for the new development.

Preliminary information provided by WA indicates that both steel and concrete structural framing schemes will have columns spaced typically 30 ft. apart around the building perimeter and low-rise areas, and 15 to 30 ft. apart within the high-rise portion of the building. The five basements will be constructed of reinforced concrete walls and floor slabs. The lowest level floor slab, approximately at El. -32, extends to a depth of about 60 ft. along Bedford Street and 50 ft. along Essex Street below the present site grades.

Preliminary column loading (total LL and DL) information provided by WA is summarized below:

	Low-Rise <u>(tons)</u>	Tower <u>(tons)</u>
<u>Concrete Frame:</u>		
Typical Exterior Column	1200	3100
Typical Interior Column	1750	4700-5600
<u>Steel Frame:</u>		
Typical Exterior Column	975	1400
Typical Interior Column	1250	3200



II. FIELD AND LABORATORY INVESTIGATIONS

2-01. TEST BORINGS

Prior to the present study, Haley & Aldrich, Inc., (H&A) conducted a preliminary geotechnical study for the proposed development based on readily-available subsurface information. The results of that study were presented in a report to Jung/Brannen Associates, Inc., entitled "Report on Preliminary Geotechnical Evaluation, Proposed Kingston/Bedford Development, Boston, Massachusetts," dated 6 May 1988. The previous test boring information in the vicinity of the proposed site was contained therein.

Ten test borings, designated B101 through B110, were drilled at the site by Geo Logic, Inc., Watertown, Massachusetts, during the period 14 December 1988 to 13 January 1989. The purpose of these borings was to obtain information on soil composition and density, stratum thickness, and depths to groundwater and bedrock, as required for foundation design. The test borings were also planned to meet the needs of the oil and hazardous material site assessment (Chapter 21E) which was undertaken concurrently for the proposed development. All borings were monitored by an H&A geologist. Boring logs prepared by Geo Logic and reviewed by H&A are included in Appendix A.

All borings were advanced by washing and utilizing a 4.0-in. I.D. casing to depths ranging from 66 to 92 ft. below the present ground surface. Standard split-spoon soil samples (ASTM D1586) were obtained at intervals generally not exceeding 5 ft., except continuous samples were taken through the existing fill soils at selected boring locations as required for the Chapter 21E site assessment.

Groundwater observation wells (2-in. diameter) were installed in completed borings B101, B102, B104, B107 and B108 for the purpose of monitoring groundwater levels, and for groundwater sampling within the scope of the Chapter 21E study. Observation well installation and groundwater monitoring reports are included in Appendix B.

Locations of test borings as shown on Figure 2 were determined by H&A, by taping from existing building corners. Ground surface elevations at test boring locations were estimated from



nearby spot elevations provided on the Survey Engineers of Boston site plan.

2-02. TEST PIT EXCAVATIONS

Two test pits were excavated by Crossroads Construction Inc. on 7 January 1989 under the supervision of the H&A project engineer. As shown on Figure 2, the test pits (TP1 and TP2) were excavated in the existing parking lot managed by Allright Boston Parking, Inc. The purpose of the test pits was to observe and document the type, geometry, bearing level and physical condition of foundations supporting the Bedford Building, which must be protected during the proposed construction. It was originally planned that one test pit on the west and the other on the south side of the Bedford Building would be excavated adjacent to the proposed development. However, as previously discussed, a below-grade vault beneath the sidewalk prevented excavation of a test pit along the Columbia Street side of the building.

The test pit log for TP1 prepared by H&A, along with photographs taken following completion of the test pit, are included in Appendix C. Because of the limited information obtained at TP2, a log was not prepared for this test pit. Discussion of observations made in both test pits is provided in Section 3-04 of this report.

2-03. LABORATORY TESTING

A laboratory soil testing program consisting of grain size distribution analyses and natural water content tests were conducted on selected soil samples obtained from the test borings. The test data have provided general information on classification of the soils encountered at the site.

Water content and grain size distribution tests were performed in accordance with ASTM D2215 and ASTM D422, respectively. Laboratory test results are included in Appendix D.



III. SUBSURFACE CONDITIONS

3-01. GENERAL

Subsurface soil and rock strata encountered at the site, as indicated by the referenced test borings, are listed below in order of increasing depth below ground surface:

- o Miscellaneous Fill
- o Marine Clay
- o Glacio-Marine Silt
- o Glacial Till
- o Decomposed Argillite (Bedrock)

The above sequence reflects the general order of occurrence of the units below ground surface. However, one or more strata may not be present at a particular location. Specific descriptions of soil samples recovered in the test borings are provided in the boring logs included in Appendix A. A summary of subsurface conditions encountered at the locations of test borings is presented in Table I.

3-02. SUBSURFACE STRATA

The subsurface soils and rock underlying the site reflect the successive effects of glaciation, a subsequent estuarine marine environment, and various phases of man-placed filling. Generalized descriptions of the various strata encountered are given below.

- o Miscellaneous Fill: Fill was encountered in all explorations, ranging from 7.5 to 18.5 ft. in thickness. The fill consists of loose to dense, brown to gray, coarse to fine sand with varying amounts of gravel, silt, clay, bricks, cinders, and other building rubble. Granite blocks and reinforced concrete remnants of old foundations were encountered in the fill at several boring locations.
- o Marine Clay: This stratum consists of yellow-brown to gray, silty clay, with frequent partings and lenses of fine sand. Several borings (B103, B104, B106 and B108) encountered interbedded layers of silty fine sand to fine sand, up to 2.5 ft. in thickness. The clay stratum ranges



in thickness from about 12 to 37 ft. The upper 10 to 12 ft. has a hard to stiff consistency due to dessication and oxidation, becoming medium stiff with increasing depth. As indicated by the borings, the clay stratum is thinner along Bedford Street and increases in thickness rather uniformly proceeding south to Essex Street.

- o Glacio-Marine Silt: A glacial till-like stratum of glacio-marine soil variable in composition was encountered underlying the marine clay at seven of the ten test boring locations. Relatively higher silt-clay content, lower blow counts "N" and lack of interparticle bonding distinguish this material from the underlying glacial till.

The glacio-marine deposit ranges from about 7 to 29 ft. in thickness at the boring locations when encountered and consists of gray, dense to very dense clayey silt with some to little fine sand, or fine sandy silt with some clay. The top of the glacio-marine soils was encountered at elevations ranging from approximately El. 3 (B101) to El. -26 (B107).

- o Glacial Till: A very dense, heterogeneous glacial deposit referred to as glacial till was encountered in all test borings. The glacial till stratum ranges in thickness from about 6 to 31 ft. or greater (where borings terminated in the till) at the boring locations. The till consists of gray to brown silty medium to fine sand to fine sandy silt, some to trace gravel, coarse to fine sand and clay. The elevation at which the top of this stratum was encountered varied from approximately El. -19 (B108 and B109) to El. -46 (B107).

Glacial till encountered was typically very dense, with blow counts "N" generally in excess of 50 blows per foot, and was observed to be well bonded.

Bedrock: Six of the ten test borings were advanced to bedrock which was encountered at depths from about 68 to 78 ft. at the boring locations. The top of the rock ranged in elevation from El. -41 (B101) to El. -56 (B105). Five to 15 ft. of bedrock was cored at five boring locations.

The bedrock is known locally as the Cambridge Argillite. Close examination of the rock samples in the laboratory



indicated that the top of the bedrock had been subjected to some degree of hydrothermal alteration. This process is relatively common throughout the Boston Basin and results in a zone of softer bedrock than the underlying intact bedrock. Apparent hydrothermal alteration of the bedrock was observed at B102, B104, B105 and B107.

A majority of the rock was slightly to completely weathered, except at B110, where slight to moderate weathering was observed. The "continuity" of the rock core, which is a description of natural fractures in the rock, is classified as extremely to moderately fractured at all test boring locations (fractures at every 1 to 4 inches of core length). Rock quality as measured by RQD (Rock Quality Designation) was estimated to range from 0 to 26 percent indicating a very poor to poor rock quality.

3-03. GROUNDWATER LEVELS

Groundwater levels measured through the five observation wells installed at the project site are included in Appendix B. Stabilized groundwater levels measured in the wells during the period of investigation (14 December 1988 to 13 January 1989) and water levels measured in completed boreholes are given in Table 1.

Groundwater levels measured in observation wells indicate stabilized water levels at depths of about 13 to 22 ft. below the present ground surface, corresponding to elevations ranging from El. 4.9 at B101(OW) to El. 10.3 at B108(OW).

Typically, groundwater level was observed within the fill stratum or close to the fill/marine clay interface.

It should be noted that groundwater levels may fluctuate with precipitation, season, temperature, and may be influenced by adjacent structure foundation systems or drainage into existing sewer or storm drain systems. Consequently, water levels observed during construction may vary from those observed during the exploration program.



3-04. TEST PITS

Two test pits were excavated along the south foundation wall of the existing Bedford Building (99 Bedford Street) to observe pertinent features and the general physical condition of the foundations. Test pits encountered the following conditions:

- o Test Pit No. 1: The pit was excavated at the southwest corner of the existing building (see Figure 2). Conditions observed in TP1 are documented on Figure C-1, Appendix C. As depicted in the figure, remnants of the foundation wall and the partially demolished first level floor slab (top El. 18.5) belonging to the demolished 10-story parking garage were identified. It appears that during demolition the below-grade foundation walls, floor slab and the buildings foundation units were left partially or completely intact. It is anticipated that the garage foundation consisted of footings bearing on the clay or caissons bearing on the glacial till and/or glacio-marine silt.

As shown in the photographs provided in Appendix C, the fill consisted mainly of building rubble (reinforced concrete) mixed with granular soil. Also, large void spaces were observed within the fill.

Although the lowest level floor slab of the demolished garage could not be reached in TP1, it is believed the top of slab is at approximately El. 9. Test boring B109 encountered 6-in. of concrete at this elevation. Large pieces of reinforced concrete and a maze of twisted reinforcing steel prevented further excavation.

It is expected that the foundations for the Bedford Building are probably consisted of granite blocks bearing on the top of the marine clay stratum at approximately El. 13.5, as determined from nearby test boring B105. It is also anticipated that during the construction of foundations for the more recent, adjacent 10-story garage which extended below the foundation level of the Bedford Building, some form of underpinning was undertaken to secure the Bedford Building foundations.

- o Test Pit No. 2: TP2 was excavated to the top of the partially demolished first level slab (El. 18.5) of the



garage structure. Observations made were quite similar to those at TP1. Because of difficulty in backfilling TP1 due to the presence of large void spaces and insufficient quantity of backfill material, TP2 was excavated to minimum dimensions allowing limited observations.



IV. FOUNDATION ENGINEERING EVALUATION AND DESIGN RECOMMENDATIONS

4-01. FOUNDATION SYSTEM

Based on the proposed building geometry, loading conditions, basement levels, and other design requirements, it is recommended that the proposed structure be supported on reinforced concrete footings bearing at shallow depths below the lowest basement level. The subgrade soil directly beneath the lowest level slab (approximately El. -32) consists of glacial till over a large portion of the building footprint. However, the glacio-marine silt is present at subgrade level in the general area of test borings B103, B107 and B110. Both soil deposits are suitable for direct support of footing foundations.

It is recommended that a maximum design bearing pressure of 15 tons per sq.ft. (tsf) be used in proportioning the footings bearing on the undisturbed glacial till and/or glacio-marine silt.

It should be noted that the recommended maximum design bearing pressure is greater than the presumptive value currently allowed by the Massachusetts State Building Code (Table 720). The recommended higher design value was determined based on the recent H&A experience with the results of in-situ Menard pressure-meter tests conducted within the glacial till soils underlying the 125 Summer Street project across Lincoln Street. In addition, the results of the in-situ pressure-meter tests conducted in the glacial till at the sites of the 125 High Street, the Rows Wharf and International Place projects, all a few blocks away from the project site, were utilized in making this recommendation.

An approval from the Building Official to use the recommended value may be required.

If, during foundation excavation, relatively soft, local zones of glacio-marine deposits are encountered at the design bearing level, these soils should be removed by overexcavation and back filled with lean concrete. The suitability of the foundation bearing soils should be monitored and determined by the Project Geotechnical Engineer.



4-02. SETTLEMENT

The settlement of columns and walls supported on footings bearing on the undisturbed, dense glacial till and/or glacio-marine silt at the proposed design grade (approximately El. -35) will result primarily from elastic deformations of the foundation/soil system. It is expected that most of the settlement will occur during construction as the loads are applied. It is expected that no significant post-construction settlements will occur.

Total settlement of the foundation units for the dead plus live column loads estimated by WA is estimated to range from 1/2 to 1-1/2 inch in proportion to the magnitude of the loads. Differential settlements between heavily loaded interior columns and lightly loaded perimeter columns are estimated to be between 1/4 and 3/4 inch.

4-03. MODULUS OF SUBGRADE REACTION

It is recommended that a modulus of subgrade reaction of 650 tons per sq. ft. per ft. for the glacial till and glacio-marine silt be used in design of the foundation units. The stated modulus value is for a 1 ft. square rigid plate bearing at the proposed foundation grade. For actual foundation bearing areas the appropriate modulus should be calculated as follows:

$$K(s) = K(s,1) (m+0.5)/1.5m$$

where: $m = L/B$

L = Length of footing (ft)

B = Width of footing (ft)

$K(s,1)$ = Modulus of subgrade reaction for a 1 ft. x 1 ft. plate; 650 tons per sq.ft. per ft.

$K(s)$ = Modulus of subgrade reaction for a footing $L \times B$ in size.

For wall footings, a value of $K(s) = 0.67 K(s,1)$ should be used. Wall footings should have a minimum width of 3 ft.



4-04. DESIGN GROUNDWATER LEVEL

As previously discussed in Section 4-03., water levels observed through observation wells installed at the site have ranged from approximately El. 5 to El. 10. Based on these data, a design water level of El. 12 is recommended for project design purposes.

4-05. LOWEST LEVEL FLOOR SLAB

Based on subsoil and groundwater conditions observed at the site, it is recommended that the lowest level floor slab be designed as a slab-on-grade with a permanent underdrainage system to relieve the hydrostatic uplift pressures.

Permanent relief of the hydrostatic pressures beneath the floor slab must take into consideration the potential adverse effects of lowered groundwater on adjacent structures and utilities. It is anticipated that the piezometric levels in the glacial till and glacio-marine silt underlying the foundation will be lowered to some degree by the permanent underdrain system. However, since these soils are quite incompressible, it will preclude any significant post-construction settlements caused by the drop in piezometric level. The groundwater levels in the fill and clay surrounding the project site should, however, be maintained as close to the preconstruction levels as possible, as lowered levels could have potential adverse effects on structures and utilities founded in the fill and the adjacent Bedford Building and Expressway tunnel which bears directly on the marine clay.

Therefore, as long as the water levels outside the site are maintained after foundation construction is complete, the lowest level floor slab can be designed as a slab-on-grade relieved by a permanent underslab drainage system, subject to the following considerations:

- o Hydraulic connection between the groundwater in the fill and clay and the underdrainage system must be minimized. To control potential vertical flow through the zone immediately adjacent to the foundation wall, it is recommended that a series of concrete "cutoffs" with bentonite seals be constructed as shown schematically on Figure 6. The lagging boards should be removed at the

"cutoff" areas prior to concrete placement. In addition, the vertical face of column and wall footings adjacent to the lateral support system should be cast directly against the in-situ glacial till/glacio-marine silt to further minimize groundwater inflow into the underdrain system.

- o An underdrain system designed in accordance with Detail A on Figure 6 should be installed beneath the entire floor slab area.
- o Since gravity discharge will not be possible, it is recommended that the underdrain system be designed to discharge the collected water to two or more sump pits equipped with automatic pumps. In addition, the system should be provided with an emergency power source and standby pumps. Clean-outs should be placed along the underdrain lines to facilitate maintenance. The pumps and the sump pits should be sized to accommodate a maximum flow of 50 gallons per minute. Normal flows rates are expected to be much less.
- o Any pits or depressions below the lowest level basement slab, such as elevator pits, which extend below the underdrainage system should be designed to resist the hydrostatic pressure acting around and beneath the pit. In addition, to preclude the possibility of water seepage into the pits, the portions of the pits below the underdrainage system should be waterproofed and construction joints should be sealed with waterstops.

4-06. BASEMENT WALLS

A. Static Lateral Soil Pressures

Basement walls must be designed to resist lateral pressures due to a combination of soil, surcharge effects from adjacent structures such as the Bedford Building and other surface loadings, and hydrostatic forces. Recommended design static lateral loadings for the permanent foundation wall are shown on Figure 7. Effect of additional surcharge loading should be calculated on the basis of uniform lateral pressure equal to 0.5 times the vertical surcharge pressure acting on the backfill side and applied over a depth of 40 ft. below the surcharge load.



It should be noted that loadings provided on Figure 7 do not include specific surcharge loading which will be induced by the Bedford Building foundations, because, at the time of the preparation of this report, the type and geometry of the foundations as well as the foundation loads were not known.

B. Waterproofing

To help prevent minor seepage infiltration into the parking garage areas below the groundwater level, it is recommended that the joints in basement walls be sealed with waterstops. Also, appropriate waterproofing should be provided on the walls up to the design groundwater level, El. 12.

To efficiently and economically accommodate the lateral design loads imposed on the basement walls, the thickness of the foundation walls will increase with depth from ground surface. To provide for economical design, foundation walls are typically designed to have constant thickness in the span between floors with the increase in thickness made at the floor level. This increase thickness creates a "step" or shelf in the wall construction. It is recommended that the "stepped" side of the basement walls be constructed on the interior of the structure, leaving a flat, vertical surface on the exterior of the basement wall. This detail avoids ponding of groundwater on these steps and possible seepage through the wall.

4-07. SEISMIC CONSIDERATIONS

A. Soil "S" Factor

The soils below foundation bearing level qualify as a "Soil Site S1" in accordance with the Massachusetts State Building Code (Code) Section 720.5. Thus, an S-factor of 1.0 may be used in calculation of the base shear force in seismic design of the proposed building.

B. Dynamic Lateral Earth Pressure

During an earthquake occurrence, additional transient pressures will develop against the exterior basement



foundation walls of the structure due to the inertia effect of the surrounding soil strata. Since the basement walls are braced with the floor slabs, they are relatively rigid and non-yielding. This condition should be taken into account in determining the seismically induced component of the lateral earth pressure.

It is recommended that dynamic earth pressure component due to ground shaking should be considered as that provided on Figure 7.

C. Liquefaction

The Code provides criteria to evaluate the liquefaction potential of saturated, fine-grained cohesionless soils, based on Standard Penetration Resistance (Section 720.4) The term "liquefaction" describes a phenomenon in which a cohesionless soil experiences a substantial reduction in effective stress during an earthquake and acquires a degree of temporary mobility sufficient to permit substantial settlement and/or loss of bearing capacity. Based on our evaluation, it is concluded that the foundation bearing glacial till and glacio-marine soils are not susceptible to liquefaction.

V. CONSTRUCTION CONSIDERATIONS

5-01. GENERAL

The primary purpose of this Section is to comment on items related to excavation, dewatering, lateral earth support, foundation construction, earthwork and related geotechnical engineering aspects of the proposed construction. It is written primarily for the Engineer having responsibility for preparation of contract drawings and specifications. Since it identifies potential construction problems related to foundations and earthwork, it will also assist personnel who monitor the construction activity.

Prospective contractors for this project should evaluate potential construction problems on the basis of their own knowledge and experience with similar soil conditions in the Boston area, taking into account their own proposed construction methods.

In addition to the construction guidelines and recommendations made herein, foundation and lateral earth support construction should conform to the requirements of OSHA and all other applicable Municipal and State regulatory agencies.

5-02. GENERAL EXCAVATION

Based on the proposed building configuration, the foundation construction will require a major excavation to be made within the limits as shown of Figure 2. The excavation may extend within a few feet of the existing Bedford Building and curblines of adjacent streets. Assuming a general excavation bottom at El. -34, the excavation will extend approximately 62 ft. below Bedford Street and approximately 54 ft. below Essex Street. Locally, excavations will be deeper for footing and elevator pit excavations.

As previously noted, the project site is presently occupied by three buildings, which will be demolished, and paved parking lots, which were previously occupied by buildings. Therefore, it is expected that the remnants of basement floors, walls, and foundations, as well as abandoned utilities, will have to be removed as part of the general excavation. Such remnants of



existing buildings and general building rubble were encountered during the exploration program in all test borings, and in the test pits excavated along the south perimeter wall of the Bedford Building (see photographs in Appendix C).

It is expected that remnants of existing and previous building foundations will be limited to relatively shallow foundations bearing on the top of the marine clay. However, it is possible that the foundations for the larger 10-story parking garage that currently occupies a large portion of the site, and the 10-story parking garage previously located in the parking lot south of the Bedford Building, may have been founded on deep caissons bearing on the glacial till and/or glacio-marine silt underlying the marine clay. As previously mentioned, foundation information for these structures could not be located despite an intense research effort.

In addition to the existing building debris, tieback anchors from the lateral support system used in the construction of 99 Summer Street are known to exist along Bedford Street. Also, tieback anchors might also have been used during construction of the Expressway tunnel and may be encountered along portions of Essex Street.

It is expected that conventional earth moving equipment can be used for excavation of the soils at the site. However, based on our recent experience obtained during foundation excavation at 125 Summer Street, the glacial till and glacio-marine soils are very dense, and the till may contain large boulders. Hydraulic spades and other power equipment may be required for excavation of the till in confined areas where access of heavy machinery will be limited.

The subgrade soils are also relatively sensitive to erosion and disturbance. Accordingly, during the excavation and foundation construction operations, precautions must be taken to minimize disturbance to the bearing soils. The following guidelines are recommended:

- o The final cuts to design bearing levels for foundations should be delayed as long as possible to minimize the time during which the subgrade surface are exposed. Alternatively, a lean concrete "mud mat" should be placed over the exposed subgrade at the footing locations to provide protection until footing concrete is placed. In



addition, disturbance due to movement of construction equipment directly over exposed subgrade bearing soils should be avoided.

- o The exposed subgrade soils must be examined in the field by the Geotechnical Engineer to observe the strength and bearing capacity of these soils. It may be necessary to require over-excavation and replacement of weak, disturbed, or otherwise unacceptable soils.
- o Any over-excavation of disturbed or unsuitable soils below design bearing grade must be backfilled with lean concrete.

5-03. LATERAL SUPPORT SYSTEM FOR FOUNDATION EXCAVATION

A. General

An excavation as deep as 62 ft. will be required for the construction of the proposed five basement levels. As shown on Figures 2, 3, 4 and 5, there are buildings, streets, sidewalks, utilities, in close proximity to the excavation on all sides of the site. In addition, support of the existing Bedford Building will require special attention during construction. The lateral earth support system, which will be designed by the Contractor, should be reviewed by a professional geotechnical engineer (P.E.) registered in the State of Massachusetts.

The conceptual lateral support schemes as shown on Figures 3 through 5.

B. Soldier Piles and Lagging

Except for the portion of the site adjacent the Bedford Building, it is recommended that the perimeter of the excavation be supported by a system of soldier piles and lagging, braced externally by tiebacks, which will be drilled and grouted into soils surrounding the excavation. Because of the significant depth of excavation and the inability to drive piles into the dense glacial till soils, it is recommended that the soldier piles be set in pre-drilled holes. Due to presence of water bearing interbedded sand lenses and layers in the marine clay stratum, the drilled holes may have to be cased through the fill and the clay strata. Alternatively, the holes may be



stabilized by slurry. The holes should be backfilled with a lean concrete mix after the soldier piles are set. If slurry is used in drilling the holes, concrete will have to be placed by the tremie technique.

It is further recommended that the tiebacks used for support of the lateral earth support system be of a type which are regroutable and minimize potential loss of the ground during installation. Due to the presence of fine to medium sand layers in the marine clay, cased drilling operations or hollow-stem augers should be utilized.

As shown on Figure 5, special support considerations will be required along the portion of the excavation adjacent the existing Expressway tunnel, located approximately 10 ft. from the site property line. The bottom the tunnel is at approximately El. -8 (i.e., about 28 ft. below ground surface). This condition will require the first level of tiebacks to be installed at approximately El. 0 or lower, requiring the upper portion of the soldier piles be designed as a cantilever. Since the amount of soil requiring retention between the existing Expressway tunnel and the excavation support system is relatively small, the lateral pressures will be comparatively lower than the typical pressures for that depth.

As previously mentioned, existing tiebacks from the adjacent 99 Summer Street construction are known to be located below Bedford Street. These tiebacks may interfere with the drilling for the soldier pile and/or tieback installation.

C. Lateral Support Along the Bedford Building

To preserve the integrity of the abutting Bedford Building, it is recommended that a more rigid temporary lateral support system, thus less deflection under the unbalanced earth and water pressure loads, be installed along the perimeter of the excavation adjacent to the Bedford Building. Such more rigid lateral support systems include concrete diaphragm walls installed with the slurry trench technique and tangent pile walls, both technically feasible for the particular project. The final selection should be made on the basis of relative cost and construction

scheduling. Main technical features of the two alternatives are summarized below.

1. Tangent Pile Wall

Tangent pile walls are installed using conventional drilled shaft installation procedures. Typically, they are composed of 2.5 to 3.0-ft. diameter caissons which overlap each other, providing a continuous concrete wall upon completion of excavation. As first order work, the primary piles are installed. These piles are drilled to the proposed tip elevation and then backfilled with unreinforced structural concrete. Prior to the concrete in the primary piles obtains its design strength, the secondary piles are drilled through the soil and partially into the primary piles to the design tip elevation. These secondary piles are reinforced for bending with structural steel. These piles are then backfilled with structural concrete, and tiebacks are installed for lateral support as the foundation excavation progresses.

In recent deep foundation excavations in Boston a modified approach has been implemented, which in effect, eliminates the primary pile installation. As shown on Figure 5, the reinforced piles are spaced approximately at 4.0 ft. on centers leaving a small area (approximately 1 ft.) of unsupported soil between two adjacent piles. If necessary, wood lagging or shotcrete is recommended for support of soil between the piles. Plywood is attached to the steel I-beams to provide a bond breaker for removal of excess concrete during excavation.

2. Slurry Wall Construction

A tied-back concrete diaphragm wall constructed by the slurry trench method (slurry wall) may be designed to provide lateral support during foundation excavation which would also serve as the permanent foundation wall. Some issues related to slurry wall construction and pertinent to the project requirements are as follows:

- o A wall thickness of 30 in. is anticipated. A minimum of 24 in. is required for construction. Structural requirements will control the wall thickness.
- o Near surface obstructions such as building rubble, old foundations and floor slabs should be removed prior to the start of wall construction by pretrenching.
- o The wall surface is a direct reproduction of the soil surface against which the wall is cast. A loose boulder at the side of the trench removed during excavation will result in a protrusion on the surface of the wall. Occasional bumps and voids can be chipped off or filled as required. An example of a finished slurry wall for underground parking can be viewed at the 125 Summer Street project across Lincoln Street.
- o As noted, the wall can be used for support of vertical loads. The excavation and final bottom elevation of the wall must be evaluated for capacity to carry such vertical loads.

It is important that the lateral support scheme selected is adequately designed by the Contractor to support the surcharge load imposed by the existing Bedford Building.

Prior to installation of the lateral support system adjacent the Bedford Building, we recommend the foundation system of the structure be investigated further. In order to adequately design the lateral support system for this building, it is essential to understand the current foundation system and the acting foundation loads. It will be important to determine the actual foundation type, bearing level, bearing soils and the physical condition of the foundation unit. It is recommended that additional test pits be excavated along the Bedford Building foundation walls adjacent to Columbia Street (west side) and the existing parking lot (south side) prior to construction, to observe and document existing conditions.

D. Support of Major Telephone Duct and 48-in. Diameter Sewer

As previously discussed, a major telephone duct and a 48-in. diameter sewer line are located along the existing Expressway tunnel at the southeast corner of the site. The site utility plan by Survey Engineers of Boston indicates that the duct extends several feet into the development property. Based on our experience at the adjacent 125 Summer Street project, it is likely that the relocation of this duct will not be feasible, therefore, the contractor should provide the necessary measures to protect the duct.

Due to the close proximity of the duct and the sewer line to the excavation, it is recommended that they be supported by the soldier pile and lagging system proposed for the site excavation, with additional brackets and/or beams supported by the soldier piles, as necessary.

Prior to installation of the lateral support system in this area, it is recommended that test pits be excavated to determine the actual location of both the telephone duct and the sewer line.

5-04. DEWATERING

The excavation will extend approximately 40 to 45 ft. below the presently observed groundwater levels at the site. The proposed soldier pile and lagging system will allow some seepage into the excavation. In addition, seepage could occur up from the bottom of the excavation. Since the glacial till and glacio-marine silt are relatively impervious, the total volume of inflow will depend on the extent of pervious zone within these soils and especially the marine clay above, which is interbedded with water bearing sand lenses and layers.

It is anticipated that open pumping methods can be used to handle water entering the excavation. The Contractor should be prepared to install a number of sump pits and drainage ditches with properly designed filters to keep the excavation free as possible of standing water on the subgrade soils to preserve their undisturbed strength.

5-05. CONSTRUCTION MONITORING

A. Preconstruction Surveys (By Owner)

It is recommended that preconstruction surveys of nearby structures, particularly the Bedford Building, be conducted prior to the start of construction. This will protect the Owner against possible claims of damage due to the proposed new construction. A preconstruction survey will document any visible signs of distress on existing structures, including cracks in building walls, floor slabs and sidewalks.

The demolition method for the existing 10-story Bedford Street Parking Garage is not known at this time. However, recently, demolition of larger structures within Boston have been by implosion. This demolition technique has proven successful many times in an urban environment (for example, Fort Hill Square Garage and The Travelers Building), however if selected as the method of demolition, we recommend the preconstruction survey been completed prior to the implosion.

Vibration monitoring during the implosion is also recommended to assess the maximum peak particle velocity of ground motion for correlation with claims for damage.

B. Geotechnical Instrumentation (By Owner)

Geotechnical instrumentation is recommended to confirm predictions of soil and structure behavior, monitor the Contractor's performance, provide early warning of problems, and aid assessments of the need for measures to mitigate unacceptable movements.

Recommended geotechnical instrumentation include the following:

- o Offset survey points and reference points to measure horizontal and vertical movements of all adjacent structures and major utilities including the telephone duct and the 48-in. diameter sewer;
- o Reference points to monitor settlement of the new structure;

- o Reference points to monitor ground settlement behind the lateral support system;
- o Inclinometers cast into the lateral support system to monitor horizontal wall deflections; offset survey points and reference points to measure horizontal and vertical movements of the lateral support system.
- o Installation of additional observation wells and piezometers outside the site to monitor groundwater levels prior to, during, and after construction. This will provide information regarding the impacts of the construction activities on the groundwater levels outside the site limits and allow to take necessary measures to remedy any undesirable effects. In addition, this will allow monitoring of the effectiveness of the seepage cut-offs.

Specific details of the instrumentation program will need to be developed after the procedures and methods of excavation and existing building demolition have been established by the Contractor.

C. Field Monitoring During Construction (By H&A)

It has been agreed that Haley & Aldrich, Inc., will be retained to represent the Owner during foundation construction and be on-site to:

1. Observe and test, if necessary, the exposed soils at subgrade levels to confirm that in-situ conditions are consistent with those predicted for design, and to observe that the natural soils are not in some way disturbed by construction activities.
2. Observe the installation of the lateral support system, including documentation of the soil types which are encountered during soldier pile and tangent pile installation, or slurry wall installation (if used).
3. Monitor and document the installation and testing of tiebacks for the lateral earth support system.
4. Observe placement of crushed stone and the underdrain pipe system beneath the slab-on-grade.

5. Observe and test placement of compacted granular fill backfill, and perimeter groundwater cutoff system between the lateral support system and the permanent foundation wall.
6. Monitor the geotechnical instrumentation recommended above.

5-06. SPECIFICATION AND PLAN REVIEW

It is recommended that Haley & Aldrich be given an opportunity to review all final plans and specifications for the foundation system, earthwork, lateral support system, and related items to confirm that they are consistent with recommendations contained in this report.

5-07. OIL AND HAZARDOUS MATERIAL REVIEW

It is recommended that in addition to the Geotechnical Reports, the contractor review all oil and hazardous material site evaluation reports by Haley & Aldrich, Inc. A preliminary site assessment entitled "Report on Oil and Hazardous Site Evaluation, One Lincoln Street Development, Boston, Massachusetts", dated 7 March 1988, is currently available for review. Work is currently underway for a Phase II - Comprehensive Site Assessment including a risk assessment report for submission to the Massachusetts Department of Environmental Quality Engineering (DEQE). Additionally, the Massachusetts Contingency Plan (MCP) will require a Phase III - Development and Remedial Response Alternatives, and a Phase IV Final Remedial Response Plan, depending on the results of Phase II.

VI. CONCLUDING COMMENTS

This report has been prepared for specific application to the proposed One Lincoln Street Development project in Boston, Massachusetts, in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. In the event that changes in the design or location of the proposed structures are proposed, the conclusions and recommendations contained in this report should be reviewed and modified or verified in writing. Our recommendations are based in part upon data obtained from the referenced subsurface explorations. The nature and extent of variations between the explorations may not become evident until construction. If variations then appear, it may become necessary to re-evaluate the recommendations of this report.

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Tables

TABLE I

SUMMARY OF TEST BORINGS
ONE LINCOLN STREET DEVELOPMENT
BOSTON, MASSACHUSETTS

BORING NUMBER	GROUND SURFACE ELEVATION (FT)	DEPTH OF BORING (FT)	BOTTOM ELEVATION OF BORING (FT)	GROUND- WATER ELEVATION (FT)	STRATA THICKNESS (FT)								TOP ELEVATION, FT. (B.C.B)					
					MARINE				GLACIO-		GLACIAL		DECOMPOSED BEDROCK	GLACIO-		MARINE CLAY	GLACIAL TILL	BEDROCK
					FILL	CLAY	MARINE	MARINE	MARINE	TILL	TILL	MARINE		MARINE				
B101(OW)	26.5	65.2	-42.7	4.9	12.0	11.8	28.7	15.0	1.7*	14.5	2.7	-26.0	-41.0					
B102(OW)	25.0	89.5	-64.5	9.4	17.0	12.5	19.5	25.0	15.1*	8.0	-4.5	-24.0	-49.0					
B103	21.0	67.0	-46.0	14.5	9.5	32.0	22.0	3.5*	--	14.5	-20.5	-39.5	--					
B104(OW)	19.5	85.0	-65.5	6.6	9.3	36.7	--	27.0	12.0*	10.2	--	-26.5	-53.5					
B105	21.0	89.0	-68.0	1.0	7.5	30.5	8.5	31.0	11.5*	13.5	-17.0	-25.5	-56.5					
B106	19.5	66.0	-46.5	-0.5	14.0	32.5	--	19.5*	--	5.5	--	-27.0	--					
B107(OW)	21.5	92.0	-70.5	7.8	11.0	36.5	20.5	5.8	18.2*	10.5	-26.0	-46.5	-52.3					
B108(OW)	23.0	66.0	-43.0	10.3	18.5	24.2	--	23.3*	--	4.5	--	-19.7	--					
B109	24.0	68.9	-44.9	21.0	16.5	20.5	6.5	25.4*	--	7.5	-12.5	-19.5	--					
B110	25.5	80.5	-55.0	6.5	18.0	20.0	25.0	10.0	7.5*	7.5	-13.5	-37.5	-47.5					

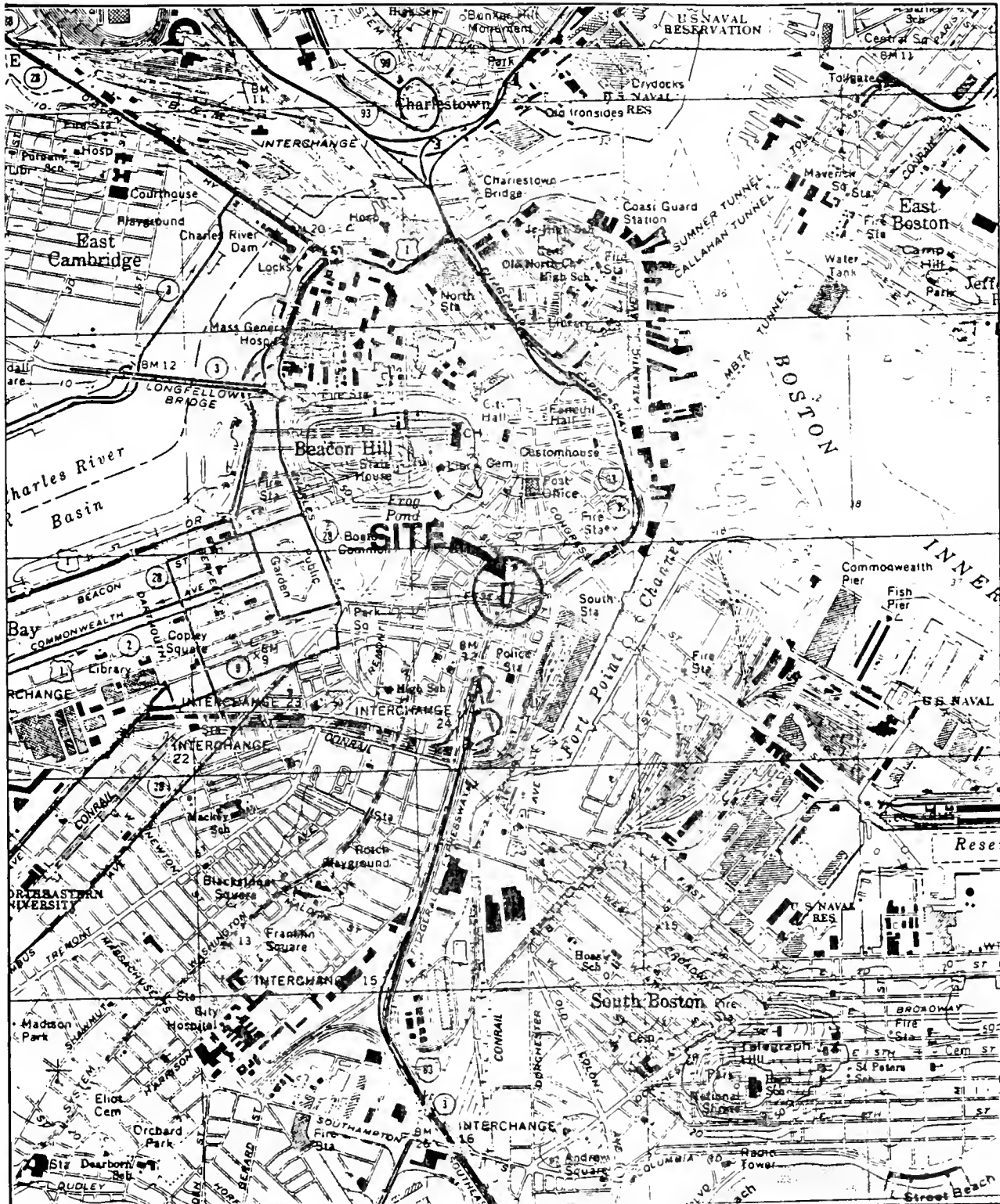
NOTES:

1. ELEVATIONS ARE IN FEET AND REFER TO BOSTON CITY BASE.
2. -- INDICATES STRATUM NOT ENCOUNTERED WITHIN DEPTH OF BORING.
3. * INDICATES DEPTH OF PENETRATION INTO STRATUM.
4. (OW) INDICATES GROUNDWATER OBSERVATION WELL INSTALLED IN COMPLETED BOREHOLE.
5. GROUNDWATER ELEVATIONS REPORTED HEREIN ARE STABILIZED MEASUREMENTS IN THE RESPECTIVE OBSERVATION WELLS. FOR HOLES WITHOUT OBSERVATION WELLS, THE REPORTED ELEVATIONS WERE MEASURED AT THE COMPLETION OF THE BORINGS AND MAY NOT REPRESENT STABILIZED GROUNDWATER LEVEL. SEE APPENDIX B FOR GROUNDWATER OBSERVATION WELL INSTALLATION AND MONITORING REPORTS.
6. GROUND SURFACE ELEVATIONS AT TEST BORINGS WERE ESTIMATED FROM NEARBY SPOT ELEVATIONS SHOWN ON A PLAN ENTITLED "TOPOGRAPHIC PLAN OF LAND, BOSTON, MASSACHUSETTS", BY SURVEY ENGINEERS OF BOSTON, DATED 25 AUGUST 1988 (DRAWING NO. 255.02L).

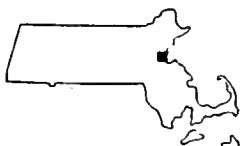
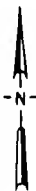
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Figures





SITE COORDINATES: 42°21'09"N 71°03'31"W



U.S.G.S. QUADRANGLE: BOSTON SOUTH, MA



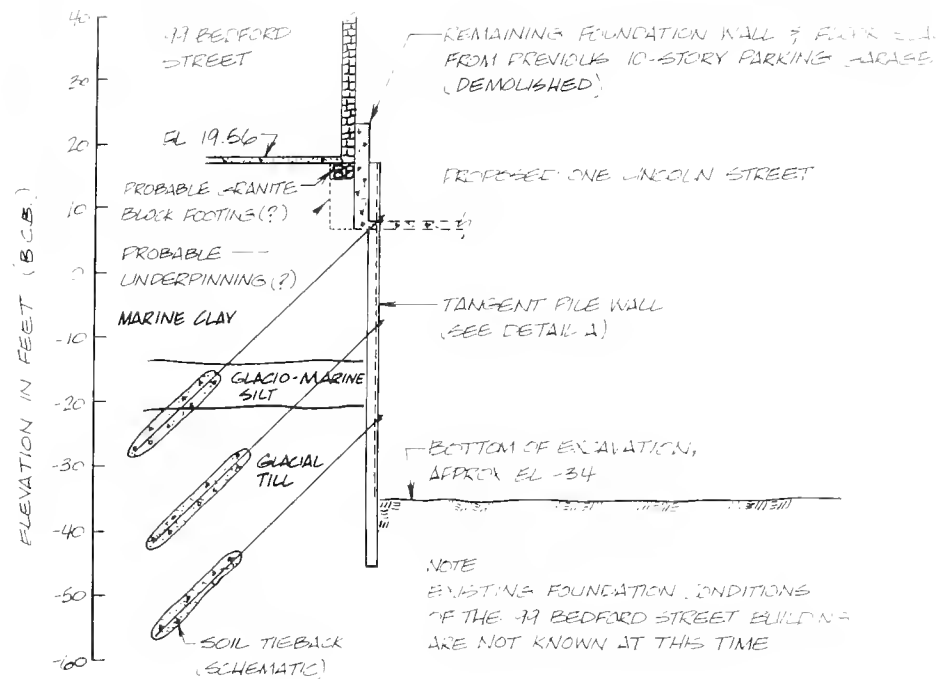
Haley & Aldrich, Inc.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

ONE LINCOLN STREET
BOSTON, MASSACHUSETTS

PROJECT LOCUS

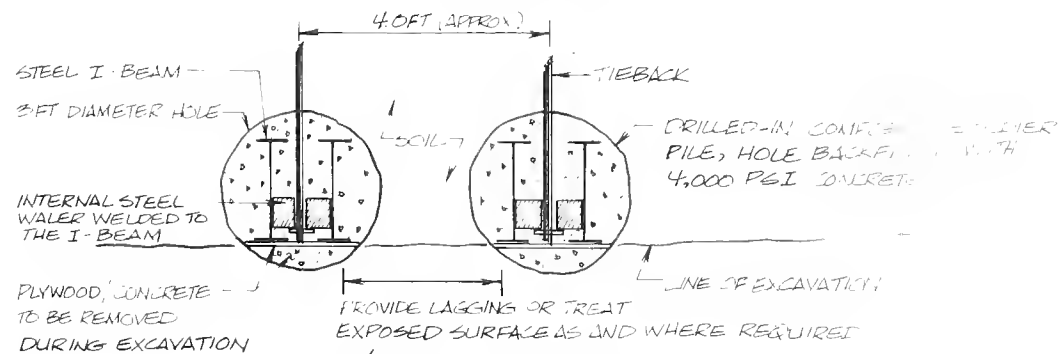
APPROX. SCALE 1:25,000

FEBRUARY 1989



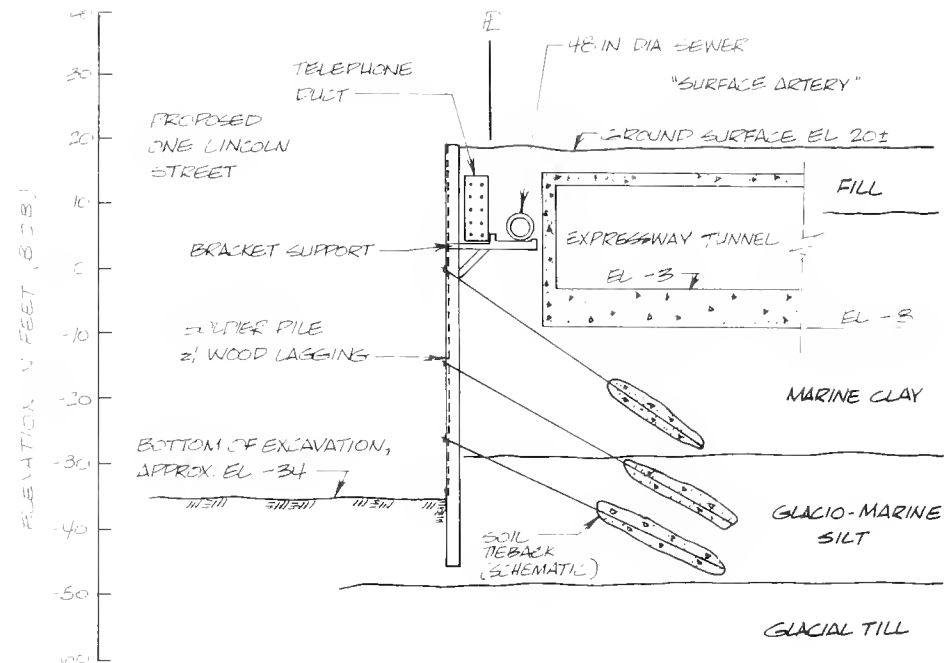
SUBSURFACE PROFILE C-C

SCALE 1" = 20'



DETAIL A - TANGENT PILE WALL

NOT TO SCALE



SUBSURFACE PROFILE D-D

SCALE 1" = 20'

NOTES

1. REFER TO FIGURE 2 FOR LOCATION SUBSURFACE PROFILES
2. SEE FIGURE 3 FOR NOTES AND LEGEND
3. THE DIMENSIONS PROVIDED IN (DETAIL A - TANGENT PILE WALL) ARE FOR GENERAL CONSIDERATIONS ONLY. THE TANGENT PILE WALL SYSTEM FOR TEMPORARY LATERAL SUPPORT OF EXCAVATION WILL BE DESIGNED BY THE CONTRACTOR TAKING INTO ACCOUNT THE LATERAL PRESSURES ACTING DURING ALL PHASES OF FOUNDATION CONSTRUCTION

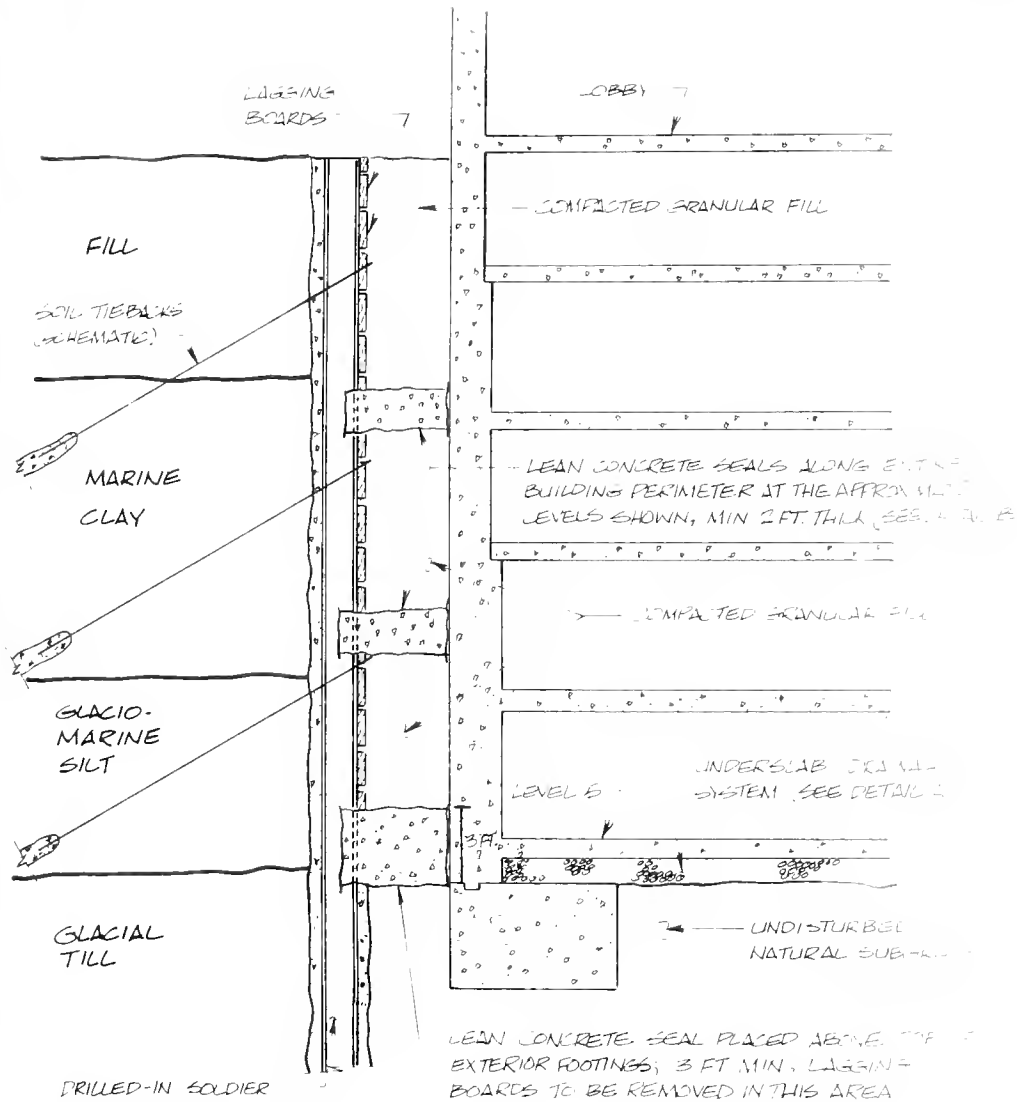
A&A Haley & Aldrich, Inc.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

ONE LINCOLN STREET
BOSTON, MASSACHUSETTS

SUBSURFACE PROFILES C-C & D-D
AND
CONCEPTUAL LATERAL SUPPORT SCHEME

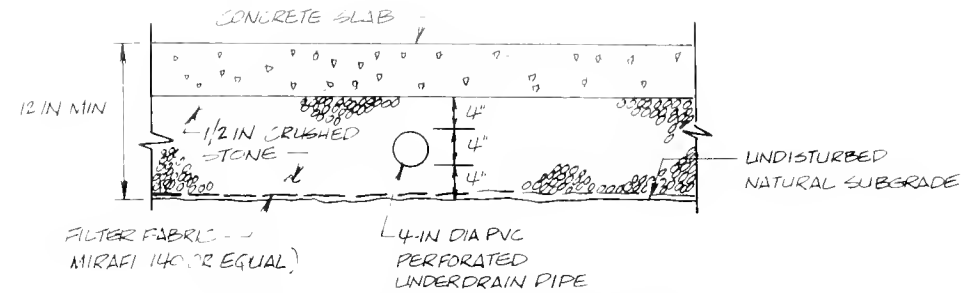
SCALE AS SHOWN

MARCH 1989



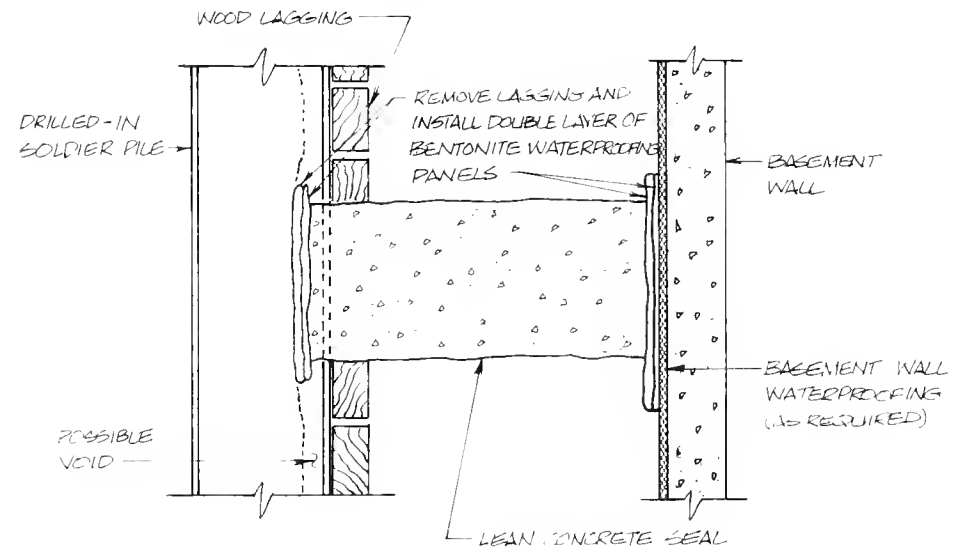
TYPICAL WALL SECTION - SCHEMATIC

(NOT TO SCALE)



DETAIL A - UNDERSLAB DRAINAGE

(NOT TO SCALE)



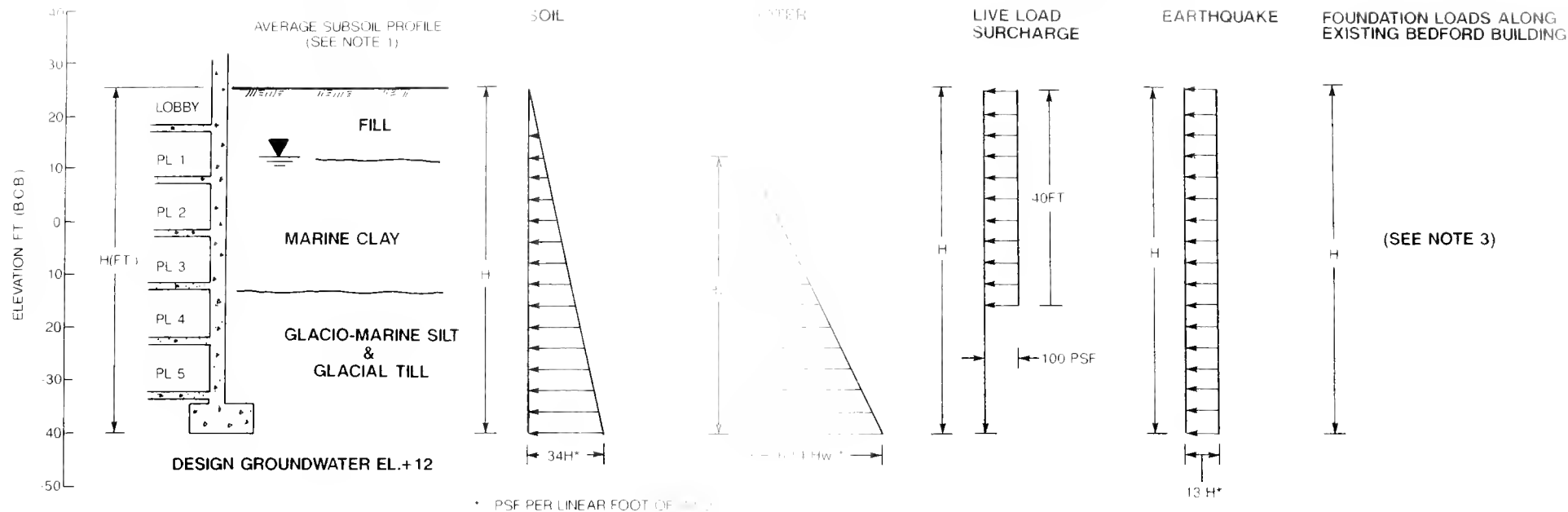
DETAIL B - CONCRETE SEAL

(NOT TO SCALE)

NOTE

CONCRETE SEAL DETAIL TO BE REVIEWED AND REVISED BASED ON FIELD CONDITIONS ENCOUNTERED

ONE LINCOLN STREET BOSTON, MASSACHUSETTS	
CONSULTING GEOTECHNICAL ENGINEERS, GEOLOGISTS AND HYDROGEOLOGISTS	
UNDERSLAB DRAIN AND PERIMETER CUTOFF TYPICAL SECTION	
NOT TO SCALE	MARCH 1989



NOTES:

1. THE RECOMMENDED SOIL PRESSURE DIAGRAMS WERE DEVELOPED FROM INFORMATION OBTAINED FROM SUBSURFACE EXPLORATIONS CONDUCTED IN THIS INVESTIGATION. THESE DIAGRAMS MUST BE REVIEWED AND REVISED, AS REQUIRED, IF CONDITIONS DIFFERENT FROM THOSE SHOWN ARE ENCOUNTERED DURING CONSTRUCTION.
2. SOIL PARAMETERS CONSIDERED TO DEVELOP THE LOADING DIAGRAMS ARE AS FOLLOWS:

SOIL STRATUM	TOTAL UNIT WEIGHT, (PCF)	ANGLE OF INTERNAL FRICTION,	UNDRAINED SHEAR STRENGTH S_u (PCF)
FILL	130	35°	-
MARINE CLAY	120	-	1500
GLACIO-MARINE SILT	140	37°	-
GLACIAL TILL	140	37°	-

3. LATERAL PRESSURES THROUGH THE EXISTING BEDFORD BUILDING FOUNDATIONS COULD NOT BE INCLUDED IN THIS FIGURE. THIS IS BECAUSE TYPE, DEPTH, GEOMETRY OF THESE FOUNDATIONS AS WELL AS LOADS PRESENTLY ACTING ON THEM ARE NOT KNOWN AT THE TIME OF PREPARATION OF THIS REPORT. THESE LOADS AND THE RESPECTIVE LATERAL PRESSURES WHICH WILL BE INDUCED ON THE PROPOSED FOUNDATION WALLS MUST BE ACCOUNTED FOR IN THE FINAL DESIGN PHASE.

HALEY & ALDRICH, INC.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

ONE LINCOLN STREET
BOSTON, MASSACHUSETTS

**RECOMMENDED DESIGN LOADS
AGAINST FOUNDATION WALLS**

SCALE AS SHOWN

MARCH 1989

Appendix A

APPENDIX A
Test Boring Logs

CASING	SAMPLER	CORE BARREL	Surface El: <u>26.5 (B.C.B.)</u>	GLI File # <u>88240</u>
TYPE <u>HW</u>	<u>SS</u>	<u>--</u>	Station _____	Driller <u>T. Paquette</u>
SIZE <u>4"</u>	<u>1 3/8"</u>	<u>--</u>	Ground water	Consultant <u>W. Rubik</u>
HAMMER <u>Spun</u>	<u>140#</u>	<u>--</u>	Date _____ Depth _____	Date Start/Finish <u>1/9-1/11/89</u>
FALL <u>--</u>	<u>30"</u>	<u>--</u>	<u>1/11/89</u> <u>20.7'</u>	

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
5'		S1	0.5'-2.5'	24"	12"	10-17	0.5'	Blacktop
						8-6		S1 M-dense brown Gravel, f-m Sand, some Silt, trace Concrete
		S2	4'-6'	24"	9"	7-4		S2 M-stiff to stiff brown fine Sandy SILT, trace m-c Sand, Fill Concrete (6.0-7.8 ft.)
						4-7		
10'		S3	9'-11'	24"	6"	4-6	12.0'	S3 M-dense brown/grey f-m SAND, trace Silt, Wood Concrete - Fill
						13-9		
5'		S4	14'-16'	24"	24"	WOR-8		S4 V-stiff yellow/brown Silty CLAY
						13-12		
10'		S5	19'-21'	24"	24"	5-5	23.8'	S5 Stiff brown/grey Silty CLAY
						9-10		
5'		S6	24'-24.6'	6"	5"	42-6/1"		S6 Hard grey SILT, little f-c Gravel, trace f-c Sand, Clay Boulders 24.5'-25.1'
						50/0"		
10'		S7	29'-31'	24"	11"	22-29		S7 Hard grey f-m Sandy SILT, trace coarse Sand, occasional seams of medium and fine Sand
						22-30		
		S8	34'-36'	24"	16"	54-42-49-47		S8 Hard grey SILT, trace f-c Gravel, f-c Sand, Clay

Proportions Used:
 Trace 0 to 10%
 Little 10 to 20%
 Some 20 to 35%
 And 35 to 50%

Cohesive Consistency (Blows/Ft.)
 0-2 Very Soft 9-15 Stiff
 3-4 Soft 16-30 V-Stiff
 5-8 M-Stiff 31+ Hard

Cohesionless Density
 0-10 Loose
 10-30 M-Dense
 30-50 Dense
 50+ V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
 2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

Geo Logic, INC

EARTH
EXPLORATION
SERVICES



74 ACTON STREET WATERTOWN, MASSACHUSETTS 02172
(617) 923-4420

CLIENT	Haley & Aldrich, Inc.	Boring #	S-101
PROJECT	Bedford-Kingston Parcel	Page 2 of 3	
LOCATION	Boston, Mass.		

CASING	SAMPLER	CORE BARREL	Surface El: _____		GLI File # 88240
TYPE	HW	SS	Station	_____	
SIZE	4"	1 3/8"	Ground water		Driller T. Paquette
HAMMER	Spun	140#	Date	Depth	Consultant W. Rubik
FALL	--	30"	1/11/89	20.7'	Date Start/Finish 1/9-1/11/89

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
40'		S9	39'-40'	24"	10"	18-16 25-26		S9 Hard grey SILT, trace fine Gravel, f-c Sand, Clay
45'		S10	44'-46'	24"	12"	26-30 46-61		S10 Hard grey SILT, little fine Sand, trace m-c Sand
50'		S11	49'-51'	24"	11"	12-15 15-15	52.5'	S11 V-stiff to hard grey SILT, little fine Sand
55'		S12	54'-55.5'	18"	13"	55-73 100/5.5"		S12 Hard grey SILT, little fine Sand, trace f-c Gravel, m-c Sand
60'		S13	59'-60'	24"	15"	31-28 48-64		S13 Hard grey SILT, trace f-c Sand
65'		S14	64'-65.5'	18"	12"	58-83 100	67.5'	S14 Hard grey SILT, trace coarse Gravel, f-c Sand
		S15	69'-69.2'	2"	0.5"	100/1"- 100/1"-300#	69.2'	S15 Grey ARGILLITE Refusal at 69.2'-bottom of hole

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks: See Page 3 of 3 for well materials

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CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring # B-101

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CASING	SAMPLER	CORE BARREL	Surface El: <u>26.5 (B.C.B.)</u>	GLI File # <u>38240</u>
TYPE <u>HW</u>	<u>SS</u>	<u>--</u>	Station _____	Driller <u>T. Paquette</u>
SIZE <u>4"</u>	<u>1 3/8"</u>	<u>--</u>	Ground water _____	Consultant <u>W. Rubik</u>
HAMMER <u>Spun</u>	<u>140#</u>	<u>--</u>	Date <u>1/11/89</u> Depth <u>20.7'</u>	Date Start/Finish <u>1/9-1/11/89</u>
FALL <u>--</u>	<u>30"</u>	<u>--</u>		

Depth	Cas bl/ft	No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description
		S1	0.5'-2.5'	24"	12"	10-17 8-6	0.5'	Blacktop S1 M-dense brown Gravel, f-m Sand, some Silt, trace Concrete
5'		S2	4'-6'	24"	9"	7-4 4-7		S2 M-stiff to stiff brown fine Sandy SILT, trace m-c Sand, Fill Concrete (6.0-7.8 ft.)
10'		S3	9'-11'	24"	6"	4-6 13-9	12.0'	S3 M-dense brown/grey f-m SAND, trace Silt, Wood Concrete - Fill
15'		S4	14'-16'	24"	24"	WOR-8 13-12		S4 V-stiff yellow/brown Silty CLAY
20'		S5	19'-21'	24"	24"	5-5 9-10	23.8'	S5 Stiff brown/grey Silty CLAY
25'		S6	24'-24.6'	6"	5"	42-6/1" 50/0"		S6 Hard grey SILT, little f-c Gravel, trace f-c Sand, Clay Boulders 24.5'-25.1'
30'		S7	29'-31'	24"	11"	22-29 22-30		S7 Hard grey f-m Sandy SILT, trace coarse Sand, occasional seams of medium and fine Sand
		S8	34'-36'	24"	16"	54-42-49-47		S8 Hard grey SILT, trace f-c Gravel, f-c Sand, Clay

Proportions Used:

Trace 0 to 10%
Little 10 to 20%
Some 20 to 35%
And 35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2 Very Soft 9-15 Stiff
3-4 Soft 16-30 V-Stiff
5-8 M-Stiff 31+ Hard

Cohesionless Density

0-10 Loose
10-30 M-Dense
30-50 Dense
50+ V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

Geo Log^{ic}. INC

EARTH
EXPLORATION
SERVICES



74 ACTON STREET WATERTOWN, MASSACHUSETTS 02172
(817) 923-4420

CLIENT

Haley & Aldrich, Inc.

PROJECT

Bedford-Kingston Parcel

LOCATION

Boston, Mass.

Boring #

B-101

Page

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CASING SAMPLER CORE BARREL

TYPE	HW	SS	--
SIZE	4"	1 3/8"	--
HAMMER	Spun	140#	--
FALL	--	30"	--

Surface El: _____

Station _____

Ground water

Date

Depth

1/11/89

20.7'

GLI File # 88240

Driller T. Paquette

Consultant W. Rubik

Date Start/Finish 1/9-1/11/89

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
40'							52.5'	S9 Hard grey SILT, trace fine Gravel, f-c Sand, Clay
		S9	39'-40'	24"	10"	18-16		
						25-26		
45'								S10 Hard grey SILT, little fine Sand, trace m-c Sand
		S10	44'-46'	24"	12"	26-30		
						46-61		
50'								S11 V-stiff to hard grey SILT, little fine Sand
		S11	49'-51'	24"	11"	12-15		
						15-15		
55'								S12 Hard grey SILT, little fine Sand, trace f-c Gravel, m-c Sand
		S12	54'-55.5'	18"	13"	55-73		
						100/5.5"		
60'								S13 Hard grey SILT, trace f-c Sand
		S13	59'-60'	24"	15"	31-28		
						48-64		
65'								S14 Hard grey SILT, trace coarse Gravel, f-c Sand
		S14	64'-65.5'	18"	12"	58-83		
						100		
							67.5'	Top of Bedrock at 67.5'
						100/1"	69.2'	S15 Grey ARGILLITE Refusal at 69.2'-bottom of hole
		S15	69'-69.2'	2"	0.5"	100/1"-300#		

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes:

1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks: See Page 3 of 3 for well materials

CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-101

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	CASING	SAMPLER	CORE BARREL
TYPE	HW	SS	--
SIZE	4"	1 3/8"	--
HAMMER	Spun	140#	--
FALL	--	30"	--

Surface El: _____
Station _____
Ground water _____
Date _____ Depth _____
1/11/89 20.7'

GLI File # 88240
Driller T. Paquette
Consultant W. Rubik
Date Start/Finish 1/9-1/11/89

Depth	Cas bi/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
								Installed well at 25.0' Well materials: 20' screen 5' solid 1 wellpoint 8 bags sand 20# bentonite 20# cement 1 roadbox

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

Geo Log_{TE} INC

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SERVICES

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CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-102

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	CASING	SAMPLER	CORE BARREL
TYPE	HW/NW	SS	NVII
SIZE	4" / 3"	1 3/8"	2"
HAMMER	Spun	140#	--
FALL	--	30"	--

Surface El: 25.0 (B.C.B.)

Station _____

Ground water

Date _____ Depth _____

12/16/88 9.5'

GLI File # 88240

Driller T. Paquette

Consultant W. Rubik

Date Start/Finish 12/14-12/16/88

Depth	Cas bl/ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
5'		S1	1'-3'	24"	6"	7-5	0.4'	Blacktop
						4-11	1.0'	Concrete
		S2	3'-5'	24"	0"	5-4		S1 Brown Silty f-m SAND, trace f-m Gravel, brick
						4-5		S2 & S3 Similar to S1
		S3	5'-6.1'	14"	5"	4-7		
10'						100/0.1'		Concrete (6.1-7.5 ft.)
		S4	7.5'-9.5'	24"	3"	3-4		S4 FILL - m-dense brown f-c Silty Sand, trc Brick, Concrete
						6-5		S5 & S6 M. stiff gray silty Clay
		S5	9.5'-11.5'	24"	8"	1-2		
		S6	11.8'-12'	4"	2"	54/4"		S6 - Brick
15'						WOR-3		Granite Slab (12.0-13.0 ft.)
		S7	13'-15'	24"	19"	4-7		S7 FILL - grey Clay, Brick, little f-c Sand, Cinders
						11-9		No recovery - pushed cobble w/SS
		S8	15'-17'	24"	0"	25-29	17.0'	
						2-6-6-6		S9 M-dense brown fine SAND, little Silt
20'		S9	17'-19'	24"	12"	w/300#		S10 Stiff grey Silty CLAY
		S10	19'-21'	24"	6"	4-6		
						5-7		
25'		S11	24'-26'	24"	12"	6-8		S11 & S12 Similar to S10
						8-10		
30'		S12	29'-29.5'	6"	6"	3-	29.5'	
		S12A	29.5-31.0	18"	14"	13-14-10		S12A V-stiff grey Clayey SILT, little f-c Sand
		S13	31'-33'	24"	18"	3-8		S13 Similar to S12A
						13-18		
		S14	34'-36'	24"	15"	20-17-19-23		S14 Hrd gry Clayey SILT, f-c Sand

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

Geo Log^{te}, INC

EARTH
EXPLORATION
SERVICES



74 ACTON STREET WATERTOWN, MASSACHUSETTS 02172
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CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-102

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CASING		SAMPLER	CORE BARREL	Surface El: _____		GLI File # <u>88240</u>	
TYPE	HW/NW	SS	NVII	Station _____		Driller <u>T. Paquette</u>	
SIZE	<u>4" / 3"</u>	<u>1 3/8"</u>	<u>2"</u>	Ground water		Consultant <u>W. Rubik</u>	
HAMMER	<u>Spun</u>	<u>140#</u>	<u>--</u>	Date	Depth	Date Start/Finish <u>12/14-12/16/88</u>	
FALL	<u>--</u>	<u>30"</u>	<u>--</u>	<u>12/16/88</u>	<u>9.5'</u>		

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
40'							49.0'	S15 Very stiff gray Clayey SILT trace f-c Sand
		S15	39'-41'	24"	16"	9-9 14-14		
45'								S16 Similar to S15
		S16	44'-46'	24"	12"	11-14 19-21		
50'								S17 Hard grey SILT, trace fine Gravel, some f-c Sand, some fine Sand lenses
		S17	49'-51'	24"	18"	31-42 37-34		
55'								S18 V-dense grey Silty fine SAND with Silt lenses S18A Hard grey SILT, trace f-c Sand, trace Clay, few Cobbles, Till
		S18	54'-55.5'	18"	12"	39-57		
60'		S18A	55.5-56.0	6"	5"	78		
								S19 - S21 Similar to S18A
65'								
		S19	59'-60'	12"	11"	50-100		
		S20	64'-65.5'	18"	8"	57-55 110		
		S21	69'-71'	24"	22"	35-39-34-43		

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes:

- The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
- Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

Geo Logic, INC.

EARTH
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SERVICES



74 ACTON STREET WATERTOWN, MASSACHUSETTS 02172
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CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-102

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CASING SAMPLER CORE BARREL

TYPE	HW/NW	SS	NVII
SIZE	4" / 3"	1 3/8"	2"
HAMMER	Spun	140#	--
FALL	--	30"	--

Surface El: _____

Station _____

Ground water

Date _____ Depth _____

12/16/88 9.5'

GLI File # 88240

Driller T. Paquette

Consultant W. Rubik

Date Start/Finish 12/14-12/16/88

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
75'							74.4'	S22 Similar to S18A S22A Highly weathered ARGILLITE
		S22	74'-74.4	6"	6"	54-		
		S22A	74.4-74.6	2"	2"	100/2"		
80'							79.5'	No recovery R1 Light grey ARGILLITE, highly fractured MPF - 3.5, 3, 3.5, 3.5, 3
		S23	79.5'-79.5'	0"	0"	50		
		R1	79.5'-84.5'	60"	48"	NVII		
85'							89.5'	R2 Similar to R1 MPF - 3, 3.5, 2.5, 2.5, 3
		R2	84.5'-89.5'	60"	50"	NVII		
							Bottom of hole at 89.5' Installed well at 25.0' Well materials: 15' screen 10' solid 1 wellpoint 12 bags sand 35# bentonite 1 roadway box 30# cement	

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Herd

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:



CLIENT Haley & Aldrich, Inc.

PROJECT Bedford-Kingston Parcel

LOCATION Boston, Mass.

Boring #

B-103

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CASING SAMPLER CORE BARREL

TYPE	HW/NW	SS	--
SIZE	4" / 3"	1 3/8"	--
HAMMER	Spun	140#	--
FALL	--	30"	--

Surface El: 21.0 (B.C.B.)

Station _____

Ground water

Date _____ Depth _____

1/12/89 9.0'

1/13/89 10.5'

GLI File # 88240

Driller T. Paquette

Consultant W. Rubik

Date Start/Finish 1/11-1/13/89

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
5'							0.1'	Blacktop Concrete
								Drilled HW Casing 0' - 9.5'
								Granite Block wall (0.8-9.5 ft.)
10'		S1	9.7'-11.7'	24'	22"	3-4	9.5'	S1 Stiff yellow Silty CLAY, with fine Sand lenses
						9-13		
15'		S2	15'-17'	24"	24"	5-4		S2 Similar to S1
						4-7		
20'		S3	20'-22'	24"	24"	8-6		Wash shows brown fine Sand (18.5- 20.0 ft.)
						5-6		S3 Yellow/grey Silty CLAY, some fine Sand lenses
25'		S4	25'-27'	24"	24"	6-5		S4 Stiff grey Silty CLAY
						6-6		
30'		S5	30'-32'	24"	24"	4-3		S5 - S7 Similar to S4
						5-4		

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:



CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-103

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2 of 2

CASING	SAMPLER	CORE BARREL	Surface El:	GLI File #
TYPE <u>HW/NW</u>	<u>SS</u>		Station _____	<u>88240</u>
SIZE <u>4" / 3"</u>	<u>1 3/8"</u>		Ground water	Driller <u>T. Paquette</u>
HAMMER <u>Spun</u>	<u>140#</u>	<u>--</u>	Date <u>1/12/89</u> Depth <u>9.0'</u>	Consultant <u>W. Rubik</u>
FALL <u>--</u>	<u>30"</u>	<u>--</u>	<u>1/13/89</u> <u>10.5'</u>	Date Start/Finish <u>1/11-1/13/89</u>

Depth	Casing ft	Sample				Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"	
		S6	35.0-37.0	24"	24"	-4- 5-6	Stiff grey silty CLAY
40'		S7	40'-41.5'	18"	18"	1-2-3	S7 Stiff grey Silty CLAY
		S7A	41.5'-42'	6"	1"	14	
							S7A V-stiff grey Clayey SILT, some fine Sand, trace coarse Sand
45'		S8	45'-47'	24"	11"	22-15 21-25	S8 Hard grey f-m Sandy SILT, some f-c Gravel, with fine Sand lenses
							S9 Hard grey SILT, trace Clay, trace fine Sand, trace f-c Gravel, trace fine Sand lenses, occasional Cobble
50'		S9	50'-52'	24"	14"	32-35 26-38	S9 Hard grey SILT, trace Clay, trace fine Sand, trace f-c Gravel, trace fine Sand lenses, occasional Cobble
							S10 & S11 Similar to S9
55'		S10	55'-57'	24"	4"	21-35 38-36	S10 & S11 Similar to S9
							S12 TILL - hard grey Silt, trace f-c Gravel, trace m-c Sand, trace Clay Bottom of hole at 67.0'
60'		S11	60'-62'	24"	1"	34-32 31-32	S12 TILL - hard grey Silt, trace f-c Gravel, trace m-c Sand, trace Clay Bottom of hole at 67.0'
							S12 TILL - hard grey Silt, trace f-c Gravel, trace m-c Sand, trace Clay Bottom of hole at 67.0'
65'		S12	65'-67'	24"	12"	32-38 37-45	S12 TILL - hard grey Silt, trace f-c Gravel, trace m-c Sand, trace Clay Bottom of hole at 67.0'
							S12 TILL - hard grey Silt, trace f-c Gravel, trace m-c Sand, trace Clay Bottom of hole at 67.0'

Proportions Used:

Trace 0 to 10%
Little 10 to 20%
Some 20 to 35%
And 35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2 Very Soft 9-15 Stiff
3-4 Soft 16-30 V-Stiff
5-8 M-Stiff 31+ Hard

Cohesionless Density

0-10 Loose
10-30 M-Dense
30-50 Dense
50+ V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:



CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-104

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CASING SAMPLER CORE BARREL

TYPE	HW/NW	SS	NVII
SIZE	4" / 3"	1 3/8"	2"
HAMMER	Spun	140#	--
FALL	--	30"	--

Surface El: 19.5 (B.C.B.)

Station _____

Ground water

Date _____ Depth _____

GLI File # 88240

Driller T. Paquette

Consultant W. Rubik

Date Start/Finish 12/22-12/26/88

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
5'		S1	0.5'-2.5'	24"	3"	12-5	0.5'	Blacktop
						5-5		S1 FILL - misc. Rubble Fill
		S2	4'-6'	24"	9"	3-2		S2 Similar to S1
						7-15		
10'							9.3'	
		S3	9.5'-11.5'	24"	20"	7-13		S3 V-stiff yellow Silty CLAY
						16-21		
15'		S4	14.5'-16.5'			6-7		S4 Similar to S3, some fine Sand lenses
						9-14		S5 Similar to S3
		S5	16.5'-17.5'	12"	9"	3-9		S5A Yellow/brown Silty fine SAND and CLAY interbedded
		S5A	17.5'-18.5'	12"	8"	10-21		S6 & S7 Similar to S5A
20'		S6	19.5'-21.5'	24"	20"	9-14		S7A Very stiff grey Silty CLAY
						14-19		S8 Medium stiff grey Silty CLAY
		S7	21.5'-22.5'	12"	9"	9-13		
		S7A	22.5'-23.5'	12"	12"	10-12		
25'		S8	24.5'-26.5'	24"	24"	2-3		
						4-4		
30'		S9	29.5'-31.5'	24"	24"	3-4		S9 Stiff grey Silty CLAY
						6-7		
		S10	34.5'-36.5'	24"	24"	2-4-4-5		S10 Similar to S9

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:



CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-104

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CASING	SAMPLER	CORE BARREL	Surface El:	GLI File #
TYPE <u>HW/NW</u>	<u>SS</u>	<u>NVII</u>	Station _____	<u>88240</u>
SIZE <u>4"/3"</u>	<u>1 3/8"</u>	<u>2"</u>	Ground water _____	Driller <u>T. Paquette</u>
HAMMER <u>Spun</u>	<u>140#</u>	<u>--</u>	Date _____	Consultant <u>W. Rubik</u>
FALL <u>--</u>	<u>30"</u>	<u>--</u>	Depth _____	Date Start/Finish <u>12/22-12/26/88</u>

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
40'		S11	39.5'-41.5'	24"	24"	1-3 3-6		S11M. Stiff grey Silty CLAY
45'		S12	44.5'-46'	18"	18"	1-3-4		S12 Similar to S11
		S12A	46'-46.5'	6"	5"	31	46.0'	S12A Hard grey Sandy SILT, some f-m Gravel
50'		S13	49.5'-51.5'	24"	5"	30-35 33-40		S13 Hard grey SILT, little f-m (trace coarse) Sand, trace f-c Gravel, trace Cobbles, Till
55'		S14	54.5'-56.3'	22"	14"	46-60 50-100/4"		S14 - S17 Similar to S13
60'		S15	59.5'-61'	18"	12"	27-43 84-50/0"		
65'		S16	64.5'-66.5'	24"	20"	22-34 45-40		
		S17	66.5'-68.5'	24"	15"	23-45 46-48		
		S18	69.5'-71.5'	24"	24"	28-33-45-54		S18 Hard gray SILT

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

Remarks:

CLIENT Haley & Aldrich, Inc.
 PROJECT Bedford-Kingston Parcel
 LOCATION Boston, Mass.

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CASING	SAMPLER	CORE BARREL	Surface El:	GLI File #
TYPE <u>HW/NW</u>	<u>SS</u>	<u>NVII</u>	Station _____	<u>88240</u>
SIZE <u>4" / 3"</u>	<u>1 3/8"</u>	<u>2"</u>	Ground water _____	Driller <u>T. Paquette</u>
HAMMER <u>Spun</u>	<u>140#</u>	<u>--</u>	Date _____ Depth _____	Consultant <u>W. Rubik</u>
FALL <u>--</u>	<u>30"</u>	<u>--</u>	<u>12/21/88</u> <u>20.0'</u>	Date Start/Finish <u>12/19-12/21/88</u>

Depth	Cas bl/ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
40'							38.0'	S11 Hard grey Sandy SILT, some f-c Sand, trace coarse Gravel S12 Similar to S11 Boulder (42.0-43.5 ft.) S13 Dense grey f-c SAND, trace fine Gravel
		S11	38.5'-40.5'	24"	10"	63-28 48-14		
		S12	40.5'-42'	18"	6"	14-27-92		
45'		S13	43.5'-45.5'	24"	7"	17-20 28-37	46.5'	S14 Hard grey SILT, trace coarse Gravel, some f-m Sand, Till S15 Hard grey Sandy SILT, trace Clay, trace fine Gravel, some fine Sand lenses, few Cobbles S16 - S19 Similar to S15
		S14	48.5'-50.5'	24"	3"	30-39 51-45		
50'		S15	53.5'-55.5'	24"	18"	14-20 19-36		
55'		S16	58.5'-60.5'	24"	15"	19-21 22-33		
60'		S17	63.5'-65.5'	24"	16"	25-39 42-37		
65'		S18	68.5'-69.4'	11"	6"	55-100/5"		

Proportions Used:
 Trace 0 to 10%
 Little 10 to 20%
 Some 20 to 35%
 And 35 to 50%

Cohesive Consistency (Blows/Ft.)
 0-2 Very Soft 9-15 Stiff
 3-4 Soft 16-30 V-Stiff
 5-8 M-Stiff 31+ Hard

Cohesionless Density
 0-10 Loose
 10-30 M-Dense
 30-50 Dense
 50+ V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
 2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
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CASING	SAMPLER	CORE BARREL				
TYPE	HW/NW	SS	NVII	Surface El:	GLI File # <u>88240</u>	
SIZE	<u>4" / 3"</u>	<u>1 3/8"</u>	<u>2"</u>	Station	Driller <u>T. Paquette</u>	
HAMMER	<u>Spun</u>	<u>140#</u>	<u>--</u>	Ground water	Consultant <u>W. Rubik</u>	
FALL	<u>--</u>	<u>30"</u>	<u>--</u>	Date	Depth	Date Start/Finish
				<u>12/21/88</u>	<u>20.0'</u>	<u>12/19-12/22/88</u>

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
75'							77.5'	S19 Hard grey Sandy SILT, trace Clay, trace fine Gravel, some fine Sand lenses, few Cobbles
		S19	73.5'-74.2'	7"	5"	100-100/3"		
80'		S20	78.5'-78.6'	2"	0"	100/2"	89.0'	Grey weathered ARGILLITE No recovery R1 Grey highly fractured ARGILLITE MPF - 3, 3, 2 R2 & R3 Similar to R1 MPF - 4, 3, 3, 3
		R1	79'-82'	36"	27"	NVII		
85'		R2	82'-86'	48"	33"	NVII		
		R3	86'-89'	36"	36"	NVII		MPF - 2.5, 3, 4 Bottom of hole at 89.0'

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

CLIENT	<u>Haley & Aldrich, Inc.</u>
PROJECT	<u>Bedford-Kingston Parcel</u>
LOCATION	<u>Boston, Mass.</u>

Boring #
B-106

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	CASING	SAMPLER	CORE BARREL	Surface El: <u>19.5 (B.C.B.)</u>	GLI File # <u>88240</u>
TYPE	<u>HW/NW</u>	<u>SS</u>	<u> </u>	Station <u> </u>	Driller <u>T. Paquette</u>
SIZE	<u>4" / 3"</u>	<u>1 3/8"</u>	<u> </u>	Ground water	Consultant <u>W. Rubik</u>
HAMMER	<u>Spun</u>	<u>140#</u>	<u>--</u>	Date <u>12/28/88</u>	Date Start/Finish <u>12/26-12/28/88</u>
FALL	<u>--</u>	<u>30"</u>	<u>--</u>	Depth <u>10.5'</u>	

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description	
		No.	Depth	Pen.	Rec.	Blows/6"			
5'							14.0'	Spun 4" casing through Rubble Fill to 14.0' and began sampling	
10'									
15'	S7	14'-16'	24"	9"	5-2		S7 Medium stiff yellow Silty CLAY		
					4-9				
20'	S8	19'-20'	11"	10"	7-12			S8 Similar to S7 S8A M-dnse brwn Silty fine SAND S9 M-dense brown Sandy SILT S9A V-stiff yellow Silty CLAY S10 M-stiff grey Silty CLAY	
	S8A	20-21	12"	12"	15-18				
	S9	21'-22.5	18"	13"	6-11-12				
	S9A	22.5-23.0	6	6	11				
25'	S10	24'-26'	24"	24"	2-3				S11 - S14 Similar to S10
					4-4				
30'	S11	28.5'-30.5'	24"	24"	3-4				
					5-6				
	S12	33.5'-35.5'	24"	20"	2-4				
					5-4				

Proportions Used:	
Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)			
0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density	
0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes:

1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.Boring #
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CASING	SAMPLER	CORE BARREL	Surface El:	GLI File #
TYPE <u>HW/NW</u>	<u>SS</u>	<u>-</u>	Station _____	<u>88240</u>
SIZE <u>4" / 3"</u>	<u>1 3/8"</u>	<u>-</u>	Ground water	Driller <u>T. Paquette</u>
HAMMER <u>Spun</u>	<u>140#</u>	<u>--</u>	Date _____	Consultant <u>W. Rubik</u>
FALL <u>--</u>	<u>30"</u>	<u>--</u>	Depth <u>10.5'</u>	Date Start/Finish <u>12/26-12/28/88</u>
			<u>12/28/88</u>	

Depth	Cas bl/ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
		S13	38.5'-40.5'	24"	24"	3-3		S13 M-stiff grey Silty CLAY
40'						5-6		
		S14	43.5'-45.5'	24"	24"	3-4		S14 Similar to S13 with trace fine Sand lenses
45'						5-7		
							46.5'	
								Boulders (46.5-47.5 ft.)
		S15	48.5'-50.2'	22"	8"	17-21		S15 Grey fine Sandy SILT, some fine Gravel, trace m-c Sand, trace Clay, Till, few Cobbles
50'						81-100/3"		
		S16	53.5'-55.5'	24"	2"	44-74		S16 - S18 Similar to S15
55'						53-62		
		S17	58.5'-60.5'	24"	13"	30-32		
60'						42-48		
		S18	64'-66'	24"	14"	36-42		
65'						37-40	66.0'	Bottom of hole at 66.0'

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:



CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-107

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CASING	SAMPLER	CORE BARREL	Surface El: <u>21.5 (B.C.B.)</u>		GLI File # <u>88240</u>
TYPE <u>HW/NW</u>	<u>SS</u>	<u>NVII</u>	Station _____	Ground water	
SIZE <u>4" / 3"</u>	<u>1 3/8"</u>	<u>2"</u>	Date <u>1/6/89</u>	Depth <u>15.5'</u>	Driller <u>T. Paquette</u>
HAMMER <u>Spun</u>	<u>140#</u>	<u>--</u>	<u>1/10/89</u>	<u>21.3'</u>	Consultant <u>W. Rubik</u>
FALL <u>--</u>	<u>30"</u>	<u>--</u>			Date Start/Finish <u>1/5-1/10/89</u>

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
		S1	0.5'-0.8'	4"	3"	100/4"	0.3'	Blacktop
								S1 Misc. Rubble FILL, Brick, Concrete, Steel, Sand, Gravel, etc.
								No recovery
5'		S2	4'-6'	24"	0"	8-2		
						9-10		
10'								CONCRETE Slab (9.0-11.0 ft.)
							11.0'	
		S3	11'-13'	24"	10"	10-12		S3 V-stiff yellow Silty CLAY, trace f-c Gravel, trace fine Sand
						17-23		S4 Hard yellow Silty CLAY
15'		S4	14'-16'	24"	24"	23-25		
						25-29		
20'		S5	19'-21'	24"	22"	10-11		S5 Similar to S4
						11-13		Cobble (21.0-21.5 ft.)
25'		S6	24'-26'	24"	24"	4-3		S6 M-stiff grey Silty CLAY
						4-5		
30'		S7	29'-31'	24"	24"	2-2		S7 - S10 Similar to S6
						5-6		
		S8	34'-36'	24"	24"	1-4-5-6		

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

	CASING	SAMPLER	CORE BARREL			
TYPE	HW/NW	SS	NVII	Surface El: _____		GLI File # 88240
SIZE	4" / 3"	1 3/8"	2"	Station _____		Driller T. Paquette
HAMMER	Spun	140#	--	Ground water		Consultant W. Rubik
FALL	--	30"	--	Date	Depth	Date Start/Finish 1/5-1/10/89
				1/6/89	15.5'	
				1/10/89	21.3'	

Depth	Cas bl/ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
10'		S9	39'-41'	24"	24"	3-4 6-7	47.5'	S9 stiff grey Silty CLAY
15'		S10	44'-46'	24"	24"	4-4 6-7		S10 Similar to S9
50'		S11	49'-51'	24"	11"	20-20 32-36		S11 Hard grey SILT, trace Clay, trace fine Sand lenses
55'		S12	54'-56'	24"	0"	19-24 21-29		No recovery - pushed cobble w/SS
		S13	56'-58'	24"	4"	24-27 51-97	68.0'	S13 Similar to S11 - pushed cobble w/SS
50'		S14	59.5'-61.5'	24"	15"	26-31 39-36		S14 & S15 Similar to S11
55'		S15	64.5'-66.5'	24"	24"	16-12 15-24		
		S16	69'-70.6'	19"	19"	33-44-51-80		S16 Glacial TILL - hard grey Silt, little fine Sand, f-c Gravel, trace Cobbles

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes:

- The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
- Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.Boring #
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CASING		SAMPLER	CORE BARREL	Surface El: _____ Station _____		GLI File # <u>88240</u>	
TYPE	HW/NW	SS	NVII				
SIZE	4"/3"	1 3/8"	2"	Ground water		Driller <u>T. Paquette</u>	
HAMMER	Spun	140#	--	Date	Depth	Consultant <u>W. Rubik</u>	
FALL	--	30"	--	1/6/89	15.5'	Date Start/Finish <u>1/5-1/10/89</u>	
				1/10/89	21.3'		

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
75'							73.8'	
80'		S17	74.5'-74.9'	5"	4"	100/5"	92.0'	S17 Weathered ARGILLITE
		R1	77'-82'	60"	17"	NVII		R1 - R5 Grey ARGILLITE, highly fractured
								MPF - 4.5, 5.5, 5.5, 5, 5
85'		R2	82'-83'	12"	12"	NVII		MPF - 3.5
		R3	83'-85'	24"	16"	NVII		MPF - 3.5, 6.5
90'		R4	85'-87'	24"	17"	NVII		MPF - 4.5, 5
		R5	87'-88.5'	18"	12"	NVII		MPF - 5, 5/6"
		R6	88.5'-92'	42"	21"	NVII		MPF - 1.5/6" 3.5, 6
90'								

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

Geo Logix, INC

EARTH
EXPLORATION
SERVICES

74 ACTON STREET WATERTOWN, MASSACHUSETTS 02172
(617) 923-4420

CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-108

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CASING	SAMPLER	CORE BARREL	Surface El: <u>23.0 (B.C.B.)</u>	GLI File # <u>88240</u>
TYPE <u>HW/NW</u>	<u>SS</u>		Station _____	Driller <u>T. Paquette</u>
SIZE <u>4" / 3"</u>	<u>1 3/8"</u>		Ground water	Consultant <u>W. Rubik</u>
HAMMER <u>Spun</u>	<u>140#</u>	<u>--</u>	Date <u>12/29/88</u>	Date Start/Finish <u>12/28-12/29/88</u>
FALL <u>--</u>	<u>30"</u>	<u>--</u>	Depth <u>9.5'</u>	

Depth	Cas bl/ft	Sample					Strata Change	Sample Description
	No.	Depth	Pen.	Rec.	Blows/6"			
5'	S1	0.5'-2.5'	24"	16"	12-10	0.5'		Blacktop
					10-12			S1 Misc. Rubble FILL, Concrete, Brick, Stone, Steel, etc.
	S2	2.5'-3.4'	9"	4"	15-100/5"			S2 - S6 Similar to S1
	S3	4.2'-5'	9"	3"	83-30/5"			
	S4	6.5'-8.5'	24"	11"	23-40			
10'					83-39			
	S5	9'-11'	24"	6"	11-12			
					23-26			
	S6	11'-12.6'	19"	4"	6-17-21			
					9/1 50/0'			
15'	S7	13'-15'	24"	3"	16-43-140	18.5'		WOOD (12.6-13.0 ft.)
					32 w/300#			S7 M-dense grey coarse SAND, some f-m Gravel, trce Silt
	S8	15.3'-17.3'	24"	3"	7-4			S8 FILL
					10-23			S9 Similar to S8
	S9	17.5'-18.5'	12"	2"	9-13			
20'	S9A	18.5-19.5'	12"	12"	4-7			Stiff yellow Silty CLAY
	S10	19.5'-21.5'	24"	13"	8-9			S10 Brown Silty fine SAND
					9-11			S11 V-stiff yellow Silty CLAY, trace fine Sand lenses
	S11	21.5'-23.5'	24"	14"	9-8			
					9-8			
25'	S12	24'-26'	24"	12"	3-2			S12 M-stiff to stiff grey Silty CLAY
					3-4			
30'	S13	29'-31'	24"	22"	4-6			S13 - S15 Similar to S12
					8-9			
	S14	34'-36'	24"	24"	2-3-3-4			

Proportions Used:

Trace 0 to 10%
Little 10 to 20%
Some 20 to 35%
And 35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2 Very Soft 9-15 Stiff
3-4 Soft 16-30 V-Stiff
5-8 M-Stiff 31+ Hard

Cohesionless Density

0-10 Loose
10-30 M-Dense
30-50 Dense
50+ V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

Geo Logic, INC EARTH EXPLORATION SERVICES 74 ACTON STREET WATERTOWN, MASSACHUSETTS 02172 (617) 923-4420	CLIENT <u>Haley & Aldrich, Inc.</u>	Boring # <u>B-108</u>
	PROJECT <u>Bedford-Kingston Parcel</u>	
	LOCATION <u>Boston, Mass.</u>	Page <u>2</u> of <u>2</u>

	CASING	SAMPLER	CORE BARREL		
TYPE	HW/NW	SS		Surface El: _____	GLI File # <u>88240</u>
SIZE	4" / 3"	1 3/8"		Station _____	
HAMMER	Spun	140#	--	Ground water	Driller <u>T. Paquette</u>
FALL	--	30"	--	Date _____	Consultant <u>W. Rubik</u>
				Depth <u>9.5'</u>	Date Start/Finish <u>12/28-12/29/88</u>

Depth	Cas bl/ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
40'		S15	39'-41'	24"	24"	2-4		S15 stiff grey Silty CLAY, w/one peice coarse Gravel
						21-15		
							42.7'	
45'		S16	44'-46'	24"	10"	26-58		S16 V-dense grey Sandy SILT, some f-c Gravel, trace Cobbles, Till
						25-17		
50'		S17	49'-49.5'	6"	0"	47/3"-140#		No recovery
						18/3"-300#		Boulder (49.5-51.0 ft.)
55'		S18	54'-56'	24"	14"	22-21		S18 TILL - hard grey Sandy Silt, trace coarse Sand, some fine Sand lenses, trace f-c Gravel
						26-23		
60'		S19	59'-61'	24"	16"	19-20		S19 & S20 Similar to S18
						26-22		
65'		S20	64'-66'	24"	18"	16-20		
						25-33	66.0'	Bottom of hole at 66.0'
								Installed well at 25.0'
								Well materials: 20' screen
								5' solid, 1 wellpt., 6 bags sand
								20# bent., 30# cement, 1 roadbox

Proportions Used:		Cohesive Consistency (Blows/Ft.)				Cohesionless Density	
Trace	0 to 10%	0-2	Very Soft	9-15	Stiff	0-10	Loose
Little	10 to 20%	3-4	Soft	16-30	V-Stiff	10-30	M-Dense
Some	20 to 35%	5-8	M-Stiff	31+	Hard	30-50	Dense
And	35 to 50%					50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
 2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:



CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-109

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1 - of - 2

CASING		SAMPLER	CORE BARREL	Surface El: <u>24.0 (B.C.B.)</u>		GLI File # <u>88240</u>	
TYPE	<u>HW</u>	<u>SS</u>	<u>--</u>	Station _____			Driller <u>T. Paquette</u>
SIZE	<u>4"</u>	<u>1 3/8"</u>	<u>--</u>	Ground water			
HAMMER	<u>Spun</u>	<u>140#</u>	<u>--</u>	Date	Depth		Consultant <u>W. Rubik</u>
FALL	<u>--</u>	<u>30"</u>	<u>--</u>	<u>1/4/89</u>	<u>15.7'</u>		
						Date Start/Finish <u>1/3-1/4/89</u>	

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
		S1	0.5'-2'	18"	4"	10-14	0.3'	Blacktop
						27		S1 FILL - brown f-m Sand, Gravel, Brick, Concrete
5'		S2	4'-6'	24"	7"	4-26		S2 - S4 Similar to S1
						11-13		
10'		S3	8.5'-10.5'	24"	10"	44-55		
						24-27		
15'		S4	14'-14.9'	8"	8"	13-66		
						50/0"		Concrete Slab (14.9-15.5 ft.)
							16.5'	Brown Sand and Gravel - Fill
20'		S5	19'-21'	24"	24"	10-10		S5 V-stiff yellow Silty CLAY
						7-8		
25'		S6	23.5'-25.5'	24"	24"	2-3		S6 M-stiff to stiff grey
						5-7		Silty CLAY
30'		S7	28.5'-30.5'	24"	4"	3-4		S7 & S8 Similar to S6
						4-4		
		S8	33.5'-35.5'	24"	12"	2-4		
						4-6		

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-109

Page
2 of 2

CASING	SAMPLER	CORE BARREL	Surface El:	GLI File #
TYPE <u>HW</u>	<u>SS</u>	<u>--</u>	<u>Station</u>	<u>88240</u>
SIZE <u>4"</u>	<u>1 3/8"</u>	<u>--</u>	Ground water	Driller <u>T. Paquette</u>
HAMMER <u>Spun</u>	<u>140#</u>	<u>--</u>	Date <u>1/4/89</u>	Consultant <u>W. Rubik</u>
FALL <u>--</u>	<u>30"</u>	<u>--</u>	Depth <u>15.7'</u>	Date Start/Finish <u>1/3-1/4/89</u>

Depth	Cas bi/ ft	Sample					Strata Change	Sample Description
	No.	Depth	Pen.	Rec.	Blows/6"			
							37.0'	
10'	S9	38.5'-40.5'	24"	15"	11-10 9-11			S9 Grey SILT, trace f-c Sand, some f-c Gravel, Cobbles
15'	S10	43.5'-45.5'	24"	9"	20-26 30-31		43.5'	S10 Hard grey SILT, trace Clay, little m-c Sand, trace fine Gravel
20'	S11	48.5'-50.5'	24"	13"	34-31 39-45			S11 Hard grey SILT, trace m-c Sand, trace Clay
25'	S12	53.5'-55.5'	24"	18"	56-31 30-30			S12 Hard grey SILT, trace m-c Sand, trace Clay, occasional Cobble, some fine Sand lenses
30'	S13	58.5'-60.5'	24"	14"	25-26 33-28			S13 - S15 Similar to S12
35'	S14	63.5'-65.1'	20"	20"	30-58 81-20/1" 50/0"			
40'	S15	68.5'-68.9'	4"	0"	49/4"-50/0"		68.9'	Bottom of hole at 68.9'

Proportions Used:
Trace 0 to 10%
Little 10 to 20%
Some 20 to 35%
And 35 to 50%

Cohesive Consistency (Blows/Ft.)
0-2 Very Soft 9-15 Stiff
3-4 Soft 16-30 V-Stiff
5-8 M-Stiff 31+ Hard

Cohesionless Density
0-10 Loose
10-30 M-Dense
30-50 Dense
50+ V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

CLIENT Haley & Aldrich, Inc.
PROJECT Bedford-Kingston Parcel
LOCATION Boston, Mass.

Boring #
B-110

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CASING	SAMPLER	CORE BARREL	Surface El: <u>25.5 (B.C.B.)</u>	GLI File # <u>88240</u>
TYPE <u>HW/NW</u>	<u>SS</u>	<u>NVII</u>	Station _____	Driller <u>T. Paquette</u>
SIZE <u>4" / 3"</u>	<u>1 3/8"</u>	<u>2"</u>	Ground water _____	Consultant <u>W. Rubik</u>
HAMMER <u>Spun</u>	<u>140#</u>	<u>--</u>	Date _____ Depth _____	Date Start/Finish <u>12/30-1/3/89</u>
FALL <u>--</u>	<u>30"</u>	<u>--</u>	<u>12/30/88</u> <u>15.5'</u>	
			<u>1/2/89</u> <u>19.0'</u>	

Depth	Cas bl/ft	Sample					Strata Change	Sample Description
	No.	Depth	Pen.	Rec.	Blows/6"			
5'	S1	0.5'-1.7'	14"	4"	3-4	0.2'	15.5'	Blacktop S1 Misc. Rubble FILL, Concrete, Brick, Steel, Wood, Sand, Gravel Concrete (1.7-3.9 ft.) S2 - S7 Similar to S1 Concrete (7.5-8.5 ft.) Concrete (9.1-10.0 ft.)
					100/3"			
	S2	4'-6'	24"	10"	17-9			
					10-8			
	S3	6'-7.5'	18"	2"	11-12			
10'					102			
	S4	8.5'-9.1'	8"	2"	15-20/1"			
					50/0"			
	S5	10'-12'	24"	4"	11-14			
					12-13			
15'	S6	12'-13'	12"	3"	8-15/6"			Concrete (13.0-13.8 ft.) Concrete (14.0-15.5 ft.)
					50/0"			
	S7	14'-14'	0"	0"	50/0"			
	S8	15.5'-17.5'	24"	3"	6-9			S8 M-dense grey f-c Gravel, little Clay, trace coarse Sand
					12-21			
20'								
	S9	19'-21'	24"	24"	9-7			S9 Stiff yellow Silty CLAY, little fine Sand lenses
					7-7			
25'	S10	24'-26'	24"	12"	4-4			S10 Stiff grey Silty CLAY
					7-8			
30'	S11	29'-31'	24"	24"	3-5			S11 & S12 Similar to S10
					7-8			
	S12	34'-36'	24"	24"	3-4-6-8			

Proportions Used:

Trace 0 to 10%
Little 10 to 20%
Some 20 to 35%
And 35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2 Very Soft 9-15 Stiff
3-4 Soft 16-30 V-Stiff
5-8 M-Stiff 31+ Hard

Cohesionless Density

0-10 Loose
10-30 M-Dense
30-50 Dense
50+ V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

Geo Log^{ic}, INC

EARTH
EXPLORATION
SERVICES



74 ACTON STREET WATERTOWN, MASSACHUSETTS 02172
(617) 923-4420

CLIENT Haley & Aldrich, Inc.

PROJECT Bedford-Kingston Parcel

LOCATION Boston, Mass.

Boring #

B-110

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CASING SAMPLER CORE BARREL

TYPE	HW/NW	SS	NVII
SIZE	4" / 3"	1 3/8"	2"
HAMMER	Spun	140#	--
FALL	--	30"	--

Surface El: _____

Station _____

Ground water

Date

Depth

12/30/88

15.5'

1/2/89

19.0'

GLI File # 88240

Driller T. Paquette

Consultant W. Rubik

Date Start/Finish 12/30-1/3/89

Depth	Cas bl/ ft	Sample					Strata Change	Sample Description
		No.	Depth	Pen.	Rec.	Blows/6"		
							38.0'	
40'		S13	39'-41'	24"	24"	16-12 10-11		S13 V-stiff Clayey SILT, some m-c Sand
45'		S14	44'-46'	24"	13"	14-14 10-11		Boulder (42.8-43.7 ft.) S14 V. st. gray clayey SILT
50'		S15	49'-51'	24"	3"	18-26 27-38		S15 Similar to S14 with gravel
55'		S16	54'-56'	24"	11"	16-17 21-22		S16 Hard grey Clayey SILT, trace f-c Sand, some fine Sand lenses
60'		S17	59'-61'	24"	18"	8-10 14-16	63.0'	S17 Similar to S16
65'		S18	64'-66'	24"	15"	21-22 32-39		S18 Hard grey SILT, little f-c f-c Sand, trace Silt
		S19	69'-70.4'	15"	10"	40-61-100/5'		S19 Similar to S18

Proportions Used:

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

Cohesive Consistency (Blows/Ft.)

0-2	Very Soft	9-15	Stiff
3-4	Soft	16-30	V-Stiff
5-8	M-Stiff	31+	Hard

Cohesionless Density

0-10	Loose
10-30	M-Dense
30-50	Dense
50+	V-Dense

Notes: 1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

Remarks:

Appendix B

APPENDIX B

Groundwater Observation Well Installation and Monitoring Reports



Haley & Aldrich, Inc.

**GROUNDWATER
OBSERVATION WELL REPORT**WELL NO. B-101 (OW)FILE NO. 06691-00PROJECT KINGSTON-BEDFORD DEVELOPMENTBORING NO. B-101LOCATION BEDFORD STREET, BOSTON, MASSACHUSETTSLOCATION See PlanCLIENT METROPOLITAN/COLUMBIA PLAZA VENTURECONTRACTOR GEO-LOGIC, INC.INSTALLATION DATE 11 Jan 89DRILLER T. PAQUETTEH&A REP W. RUBIKSURVEY
DATUM Boston City BaseGROUND
ELEVATION 26.5

SUMMARIZE SOIL CONDITIONS (NOT TO SCALE)

FILL

— 3.0 —
BENTONITE
— 4.5 —

— 12.0 —

OTTAWA
SANDMARINE
CLAY

— 23.8 —

GLACIO-
MARINE— 25.5 —
BENTONITE
— 26.5 —CRUSHED
STONE
AND
OTTAWA
SAND— 52.5 —
GLACIAL TILL
— 67.5 —
ARGILLITEELEVATION OR STICKUP ABOVE/BELOW
GROUND SURFACE OF CASING OR
ROADWAY BOX0.0ELEVATION OR STICKUP ABOVE/BELOW
GROUND SURFACE OF RISER PIPE3.0 in.

THICKNESS OF SURFACE SEAL

1.5 in.

TYPE OF SURFACE SEAL

Bentonite[INDICATE ALL SEALS SHOWING
DEPTH, THICKNESS AND TYPE]

TYPE OF CASING

Roadway Box

INSIDE DIAMETER OF CASING

3.0 in.ELEVATION/DEPTH OF BOTTOM
OF CASING2.0 in.

INSIDE DIAMETER OF RISER PIPE

2.0 in.

TYPE OF BACKFILL AROUND RISER

Ottawa Sand

DIAMETER OF BOREHOLE

4.5 in.

ELEVATION/DEPTH OF BOTTOM OF RISER

5.0 ft.

TYPE OF POINT OR MANUFACTURER

MACHINE
SLOTTED PVC

SCREEN GAUGE OR SIZE OF OPENINGS

0.010 in.

DIAMETER OF WELLPOINT

2.0 in.

TYPE OF BACKFILL AROUND POINT

Ottawa Sand

ELEVATION/DEPTH OF BOTTOM OF POINT

25.0 ft.ELEVATION/DEPTH OF BOTTOM
OF BOREHOLE69.2 ft.

Bottom of Exploration at 69.2 ft.

[FIGURES REFER TO: EL. _____ DEPTH _____ X _____]

2.0'5.0'20.0'25.0'LENGTH OF CASING (L₃)LENGTH OF RISER PIPE (L₁)LENGTH OF POINT (L₂)

PAY LENGTH

GROUND WATER MONITORING REPORT

FILE NO 06691-00

PAGE NO. 1

OW/PZ NUMBER: B101 (OW)

ELEVATION SUBTRAHEND 26.5

[illegible]

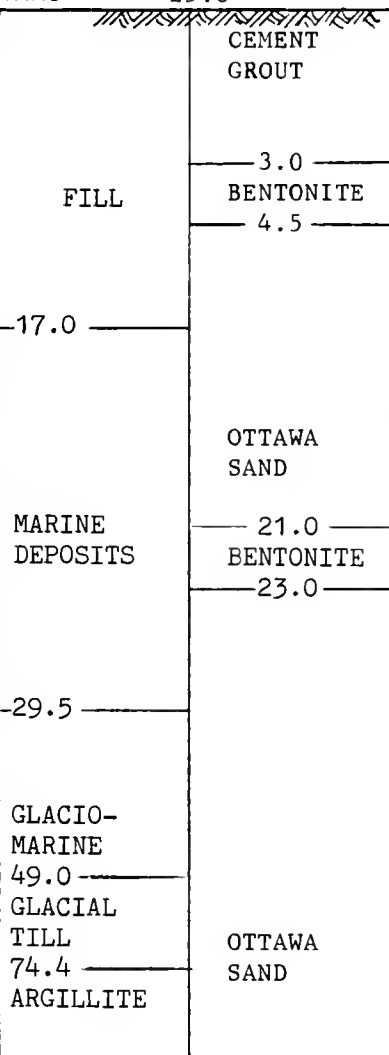
Note: Elevations refer to Boston City Base Datum



Haley & Aldrich, Inc.

**GROUNDWATER
OBSERVATION WELL REPORT**WELL NO. B-102 (OW)FILE NO. 06691-00PROJECT KINGSTON-BEDFORD DEVELOPMENTLOCATION BEDFORD STREET, BOSTON, MACLIENT METROPOLITAN/COLUMBIA PLAZA VENTURECONTRACTOR GEO-LOGIC, INC.DRILLER T. PAQUETTEBORING NO. B-102LOCATION See PlanINSTALLATION DATE 29 Dec 88H&A REP W. RUBIKSURVEY
DATUM Boston City BaseGROUND
ELEVATION 25.0

SUMMARIZE SOIL CONDITIONS (NOT TO SCALE)

ELEVATION OR STICKUP ABOVE/BELOW
GROUND SURFACE OF CASING OR
ROADWAY BOX

0.0

ELEVATION OR STICKUP ABOVE/BELOW
GROUND SURFACE OF RISER PIPE

1.0 in.

THICKNESS OF SURFACE SEAL

1.5 in.

TYPE OF SURFACE SEAL

Bentonite

[INDICATE ALL SEALS SHOWING
DEPTH, THICKNESS AND TYPE]

TYPE OF CASING

Roadway Box

INSIDE DIAMETER OF CASING

3.0 in.

ELEVATION/DEPTH OF BOTTOM
OF CASING

2.0 ft.

INSIDE DIAMETER OF RISER PIPE

2.0 in.

TYPE OF BACKFILL AROUND RISER

Ottawa Sand

DIAMETER OF BOREHOLE

4.5 in.

ELEVATION/DEPTH OF BOTTOM OF RISER

5.0 ft.

TYPE OF POINT OR MANUFACTURER

MACHINE
SLOTTED PVC

SCREEN GAUGE OR SIZE OF OPENINGS

0.010 in.

DIAMETER OF WELLPOINT

2.0 in.

TYPE OF BACKFILL AROUND POINT

Ottawa Sand

ELEVATION/DEPTH OF BOTTOM OF POINT

20.0 ft.

ELEVATION/DEPTH OF BOTTOM
OF BOREHOLE

89.5 ft.

[FIGURES REFER TO: EL. _____ DEPTH _____ X _____]

2.0

5.0

15.0

20.0

[LENGTH OF CASING (L₃)][LENGTH OF RISER PIPE (L₁)][LENGTH OF POINT (L₂)]

[PAY LENGTH]

GW = 9.1 ft. (not stabilized)

PAGE NO. 1

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Haley & Aldrich, Inc.

**GROUNDWATER
OBSERVATION WELL REPORT**WELL NO. B-104 (OW)FILE NO. 06691-00PROJECT KINGSTON-BEDFORD DEVELOPMENTLOCATION BEDFORD STREET, BOSTON, MACLIENT METROPOLITAN/COLUMBIA PLAZA VENTURECONTRACTOR GEO-LOGIC, INC.DRILLER T. PAQUETTEBORING NO. B-104LOCATION See PlanINSTALLATION DATE 26 Dec 88H&A REP W. RUBIKSURVEY
DATUM Boston City BaseGROUND
ELEVATION 19.5

SUMMARIZE SOIL CONDITIONS (NOT TO SCALE)

FILL

3.0
BENTONITE
4.5

9.3

MARINE
DEPOSITSOTTAWA
SAND

46.0

GLACIAL
TILL31.0
BENTONITE
32.0
BOREHOLE
CUTTINGS
AND OTTAWA
SAND

73.0

ARGILLITE

ELEVATION OR STICKUP ABOVE/BELOW
GROUND SURFACE OF CASING OR
ROADWAY BOX

0.0

ELEVATION OR STICKUP ABOVE/BELOW
GROUND SURFACE OF RISER PIPE

4.5 in.

THICKNESS OF SURFACE SEAL

1.5 in.

TYPE OF SURFACE SEAL

Bentonite

[INDICATE ALL SEALS SHOWING
DEPTH, THICKNESS AND TYPE]

TYPE OF CASING

Roadway Box

INSIDE DIAMETER OF CASING

3.0 in.

ELEVATION/DEPTH OF BOTTOM
OF CASING

2.0 ft.

INSIDE DIAMETER OF RISER PIPE

2.0 in.

TYPE OF BACKFILL AROUND RISER

Ottawa Sand

DIAMETER OF BOREHOLE

4.5 in.

ELEVATION/DEPTH OF BOTTOM OF RISER

5.0 ft.

TYPE OF POINT OR MANUFACTURER

MACHINE
SLOTTED PVC

SCREEN GAUGE OR SIZE OF OPENINGS

0.010 in.

DIAMETER OF WELLPOINT

2.0 in.

TYPE OF BACKFILL AROUND POINT

Ottawa Sand

ELEVATION/DEPTH OF BOTTOM OF POINT

30.0 ft.

ELEVATION/DEPTH OF BOTTOM
OF BOREHOLE

85.0 ft.

Bottom of Exploration at 85.0 ft.

[FIGURES REFER TO: EL. _____ DEPTH _____ X]

2.0

5.0

25.0 ft.

30.0 ft.

LENGTH OF CASING (L₃)LENGTH OF RISER PIPE (L₁)LENGTH OF POINT (L₂)

PAY LENGTH

PAGE NO. 1

H & A FORM 59A



Haley & Aldrich, Inc.

**GROUNDWATER
OBSERVATION WELL REPORT**WELL NO. B107-(OW)FILE NO. 06691-00PROJECT KINGSTON-BEDFORD DEVELOPMENTLOCATION BEDFORD STREET, BOSTON, MACLIENT METROPOLITAN/COLUMBIA PLAZA VENTURECONTRACTOR GEO-LOGIC, INC.DRILLER T. PAQUETTEBORING NO. B-107LOCATION See PlanINSTALLATION DATE 9 Jan 89H&A REP W. RUBIKSURVEY
DATUM Boston City BaseGROUND
ELEVATION 21.5

SUMMARIZE SOIL CONDITIONS (NOT TO SCALE)

FILL

MARINE
DEPOSITSGLACIO-
MARINE

GLACIAL

ARGILLITE

OTTAWA
SAND

BENTONITE

OTTAWA
SAND,
CRUSHED
STONE,
BOREHOLE
CUTTINGSELEVATION OR STICKUP ABOVE/BELOW
GROUND SURFACE OF CASING OR
ROADWAY BOXELEVATION OR STICKUP ABOVE/BELOW
GROUND SURFACE OF RISER PIPE

THICKNESS OF SURFACE SEAL

TYPE OF SURFACE SEAL

[INDICATE ALL SEALS SHOWING
DEPTH, THICKNESS AND TYPE]

TYPE OF CASING

INSIDE DIAMETER OF CASING

ELEVATION/DEPTH OF BOTTOM
OF CASING

INSIDE DIAMETER OF RISER PIPE

TYPE OF BACKFILL AROUND RISER

DIAMETER OF BOREHOLE

ELEVATION/DEPTH OF BOTTOM OF RISER

TYPE OF POINT OR MANUFACTURER

SCREEN GAUGE OR SIZE OF OPENINGS

DIAMETER OF WELLPOINT

TYPE OF BACKFILL AROUND POINT

ELEVATION/DEPTH OF BOTTOM OF POINT

ELEVATION/DEPTH OF BOTTOM
OF BOREHOLE

Bottom of Exploration at 92.0 ft.

[FIGURES REFER TO: EL. _____ DEPTH _____ X]

0.0

2.5 in.

1.5 in.

Bentonite

Roadway Box

3.0 in.

2.0 ft.

2.0 in.

Ottawa Sand

4.5 in.

5.0 ft.

MACHINE
SLOTTED PVC

0.010 in.

2.0 in.

Ottawa Sand

25.0 ft.

92.0 ft.

2.0

5.0

+

20.0

=

25.0

[LENGTH OF CASING (L₃)][LENGTH OF RISER PIPE (L₁)][LENGTH OF POINT (L₂)]

[PAY LENGTH]

GROUND WATER MONITORING REPORT

PAGE NO. 1

ELEVATION SUBTRAHEND 21.5[illegible]



Haley & Aldrich, Inc.

**GROUNDWATER
OBSERVATION WELL REPORT**WELL NO. B108-(OW)FILE NO. 06691-00PROJECT KINGSTON-BEDFORD DEVELOPMENTLOCATION BEDFORD STREET, BOSTON, MACLIENT METROPOLITAN/COLUMBIA PLAZA VENTURECONTRACTOR GEO-LOGIC, INC.DRILLER T. PAQUETTEBORING NO. B-108LOCATION See PlanINSTALLATION DATE 30 Dec 88H&A REP W. RUBIK

SURVEY

DATUM Boston City BaseGROUND
ELEVATION23.0

SUMMARIZE SOIL CONDITIONS (NOT TO SCALE)

FILL

CEMENT
GROUT
OTTAWA SAND
— 3.0 —
BENTONITE
— 4.5 —OTTAWA
SAND

— 18.5 —

MARINE
DEPOSITS— 42.7 —
GLACIAL
TILL— 26.0 —
BENTONITE
— 27.0 —BOREHOLE
CUTTINGSELEVATION OR STICKUP ABOVE/BELOW
GROUND SURFACE OF CASING OR
ROADWAY BOX0.0ELEVATION OR STICKUP ABOVE/BELOW
GROUND SURFACE OF RISER PIPE3.0 in.

THICKNESS OF SURFACE SEAL

1.5 in.

TYPE OF SURFACE SEAL

Bentonite[INDICATE ALL SEALS SHOWING
DEPTH, THICKNESS AND TYPE]

TYPE OF CASING

Roadway Box

INSIDE DIAMETER OF CASING

3.0 in.ELEVATION/DEPTH OF BOTTOM
OF CASING2.0 ft.

INSIDE DIAMETER OF RISER PIPE

2.0 in.

TYPE OF BACKFILL AROUND RISER

Ottawa Sand

DIAMETER OF BOREHOLE

4.5 in.

ELEVATION/DEPTH OF BOTTOM OF RISER

5.0 ft.

TYPE OF POINT OR MANUFACTURER

MACHINE
SLOTTED PVC

SCREEN GAUGE OR SIZE OF OPENINGS

0.010 in.

DIAMETER OF WELLPOINT

2.0 in.

TYPE OF BACKFILL AROUND POINT

Ottawa Sand

ELEVATION/DEPTH OF BOTTOM OF POINT

25.0 ft.ELEVATION/DEPTH OF BOTTOM
OF BOREHOLE66.0 ft.

Bottom of Exploration at 66.0 ft.

[FIGURES REFER TO: EL. _____ DEPTH X]2.0LENGTH OF CASING (L₃)5.0LENGTH OF RISER PIPE (L₁)

+

20.0LENGTH OF POINT (L₂)

=

25.0

PAY LENGTH

[illegible]

Appendix C

APPENDIX C

Test Pit Log and Photographs

PHOTO NO. 2



PHOTO NO. 4



PHOTO NO. 3

PHOTO NO. 1



PHOTO NO. 6



TEST PIT NO.2

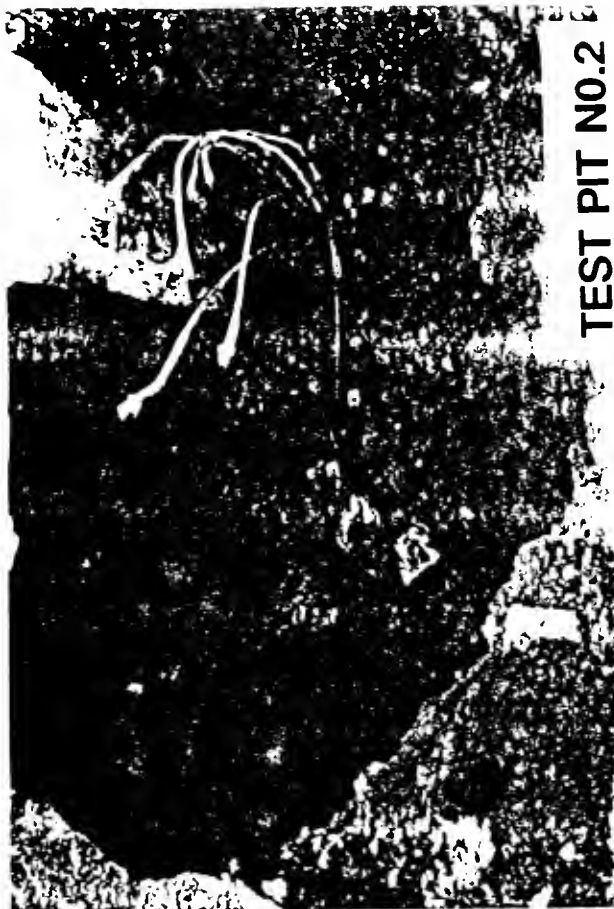
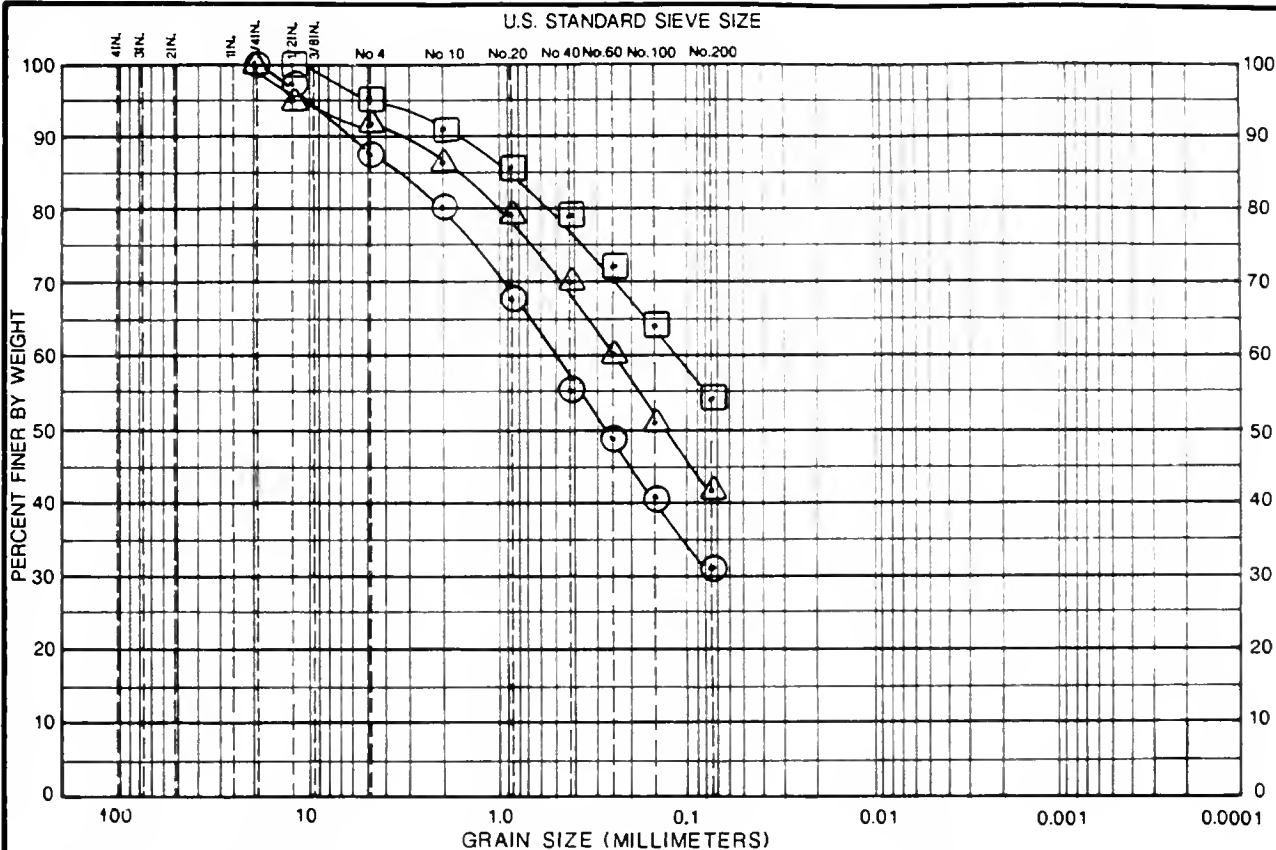


PHOTO NO. 5



Appendix D

APPENDIX D
Laboratory Test Results



UNIFIED SOIL CLASSIFICATION SYSTEM

SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
⊙	B101	S7	29.0-31.0			Brown silty medium to fine SAND, little fine gravel, trace coarse sand
△	B101	S12	54.0-55.5			Brown silty medium to fine SAND, trace fine gravel
□	B102	S14	34.0-36.0			Brown sandy SILT

SYMBOL	EXPL. NO.	SAMPLE NO.	C_u	C_c	NATURAL WATER CONTENT (%)	ATTERBERG LIMITS (%)			L O I (% by wgt.)	
						W_L	W_p	I_p		
⊙	B101	S7			10.1					
△	B101	S12			10.0					
□	B101	S14			9.8					



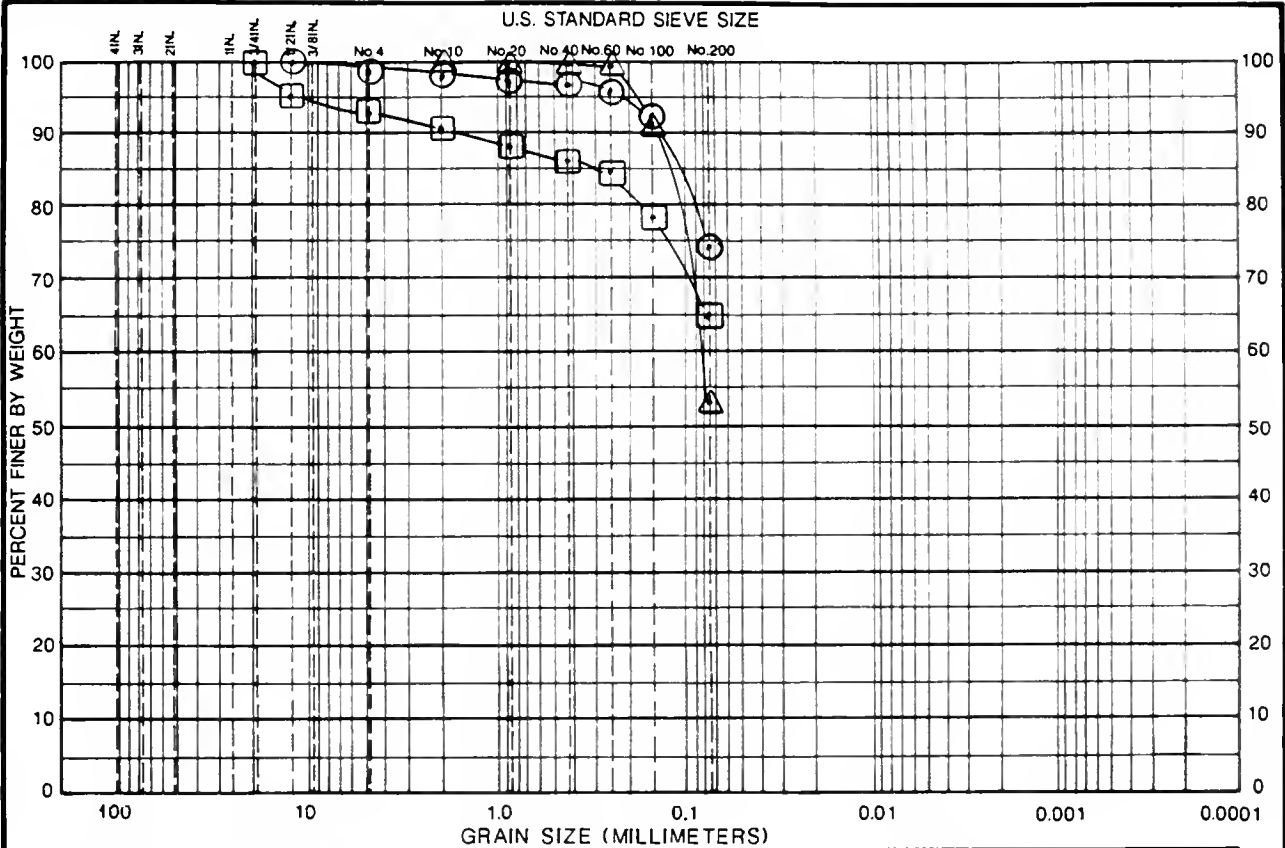
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

UNIFIED SOIL CLASSIFICATION SYSTEM

SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
⊙	B102	S18	54.0-55.0			Brown fine sandy SILT
△	B104	S6	19.5-21.5			Brown fine sandy SILT
◻	B104	S15	59.0-61.0			Brown sandy SILT, trace fine gravel

SYMBOL	EXPL. NO.	SAMPLE NO.	C _u	C _c	NATURAL WATER CONTENT (%)	ATTERBERG LIMITS (%)			L O I (% by wgt.)
						W _L	W _p	I _p	
⊙	B102	S18			15.4				
△	B104	S6			22.3				
◻	B104	S15			12.7				



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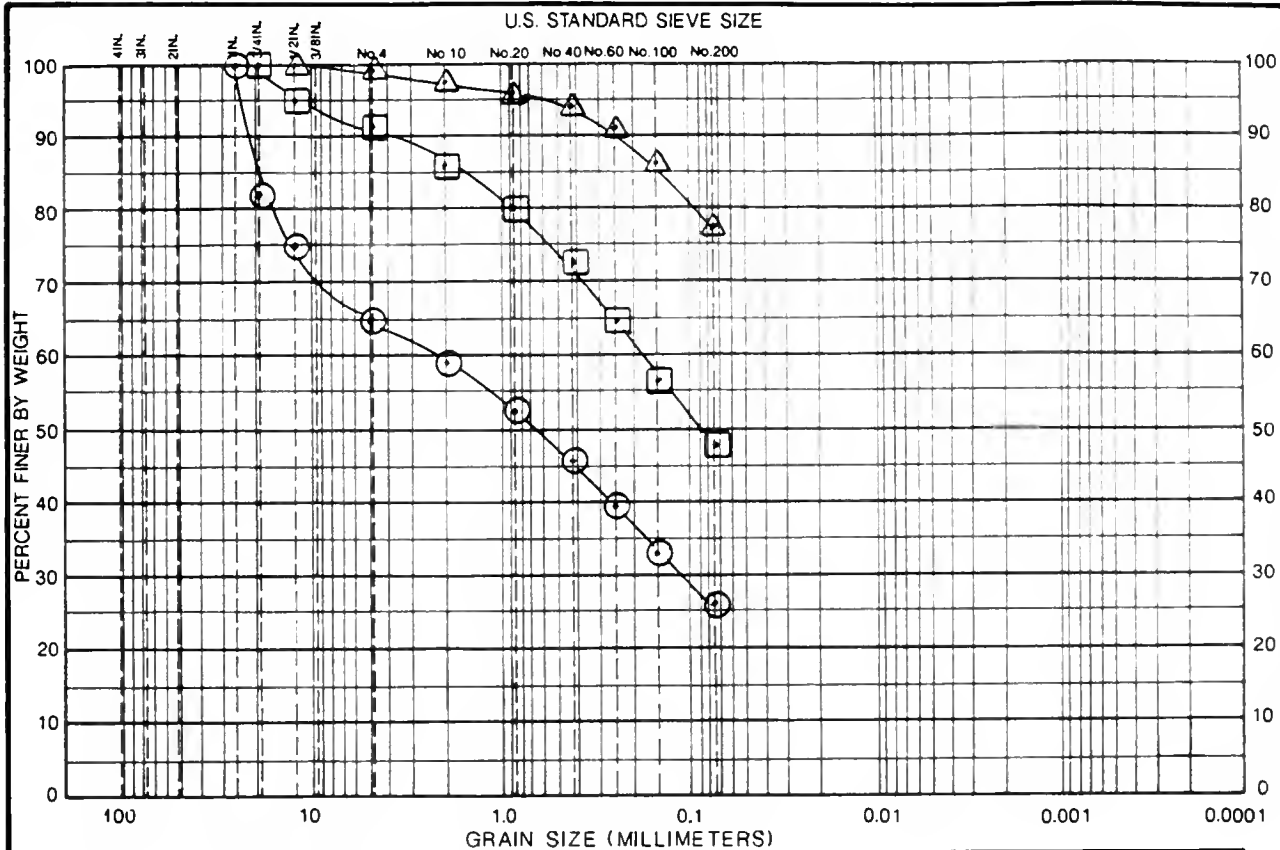
DATE: Feb. 1989

SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
⊙	B105	S13	43.5-45.5			Brown medium to fine SAND, little silt, trace fine gravel and coarse sand
△	B105	S16	58.5-60.5			Brown fine sandy SILT
□	B106	S8A	20.0-21.0			Brown silty fine SAND

SYMBOL	EXPL. NO.	SAMPLE NO.	C _u	C _c	NATURAL WATER CONTENT (%)	ATTERBERG LIMITS (%)			L O I (% by wgt.)
						W _L	W _p	I _p	
⊙	B105	S13			12.9				
△	B105	S16			11.5				
□	B106	S8A			23.9				



DATE: Feb. 1989



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

UNIFIED SOIL CLASSIFICATION SYSTEM

SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
⊙	B106	S15	48.5-50.2			Brown gravelly medium to fine SAND, some silt, trace coarse sand
△	B110	S16	54.0-56.0			Brown fine sandy SILT
□	B110	S18	64.0-66.0			Brown silty medium to fine SAND, trace fine gravel

SYMBOL	EXPL. NO.	SAMPLE NO.	C _u	C _c	NATURAL WATER CONTENT (%)	ATTERBERG LIMITS (%)			L O I (% by wgt.)
						W _L	W _p	I _p	
⊙	B106	S15			9.5				
△	B110	S16			15.2				
□	B110	S18			10.0				



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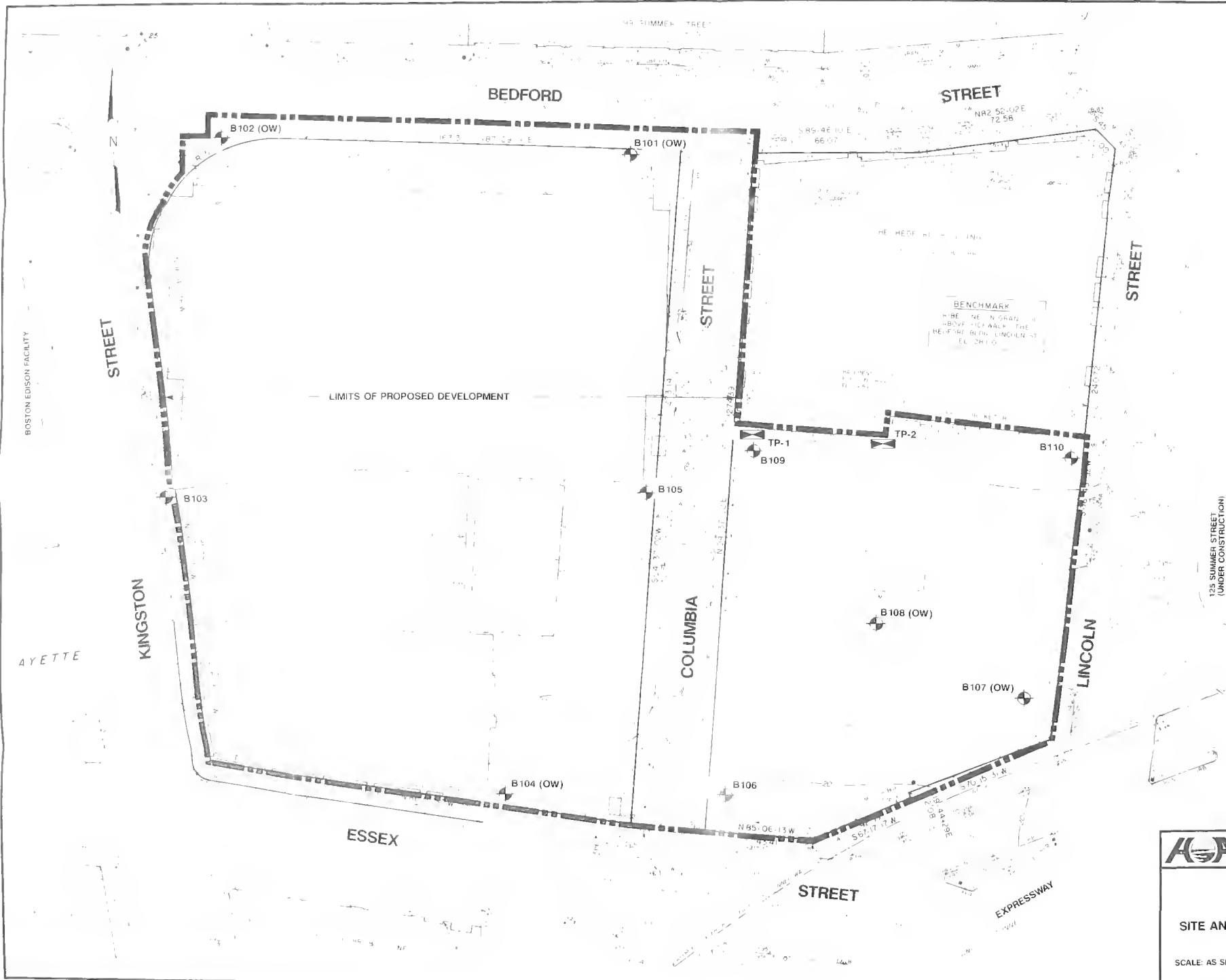
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ONE LINCOLN STREET
 BOSTON, MASSACHUSETTS

SITE AND SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN

FEBRUARY 1989

